EXHIBIT B

CURRENT CONDITIONS REPORT
FINAL
FOR
DUPONT OAKLEY SITE

VOLUME I OF IV

- TEXT
- TABLES
- FIGURES

Date: November 5, 2002
Revised September 12, 2003

Project No.: 18983684.00053

CORPORATE REMEDIATION GROUP
An Alliance between
DuPont and URS Diamond

140 Cypress Station Drive, Suite 140
Houston, Texas 77090

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VOLUME II OF IV
✦ APPENDIX 1-1 THROUGH 3-7

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PROJECT COORDINATOR CERTIFICATION

I certify that the information contained in or accompanying this submittal is true, accurate, and complete. As to those portions of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared at my direction in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted.

____
Charles H. Orwig
Project Director/Project Coordinator

January 6, 2004
Date

Work Program Certification

This report represents the current state of knowledge regarding the E. I. du Pont de Nemours and Company facility in Oakley, California concerning historic releases of chemical constituents to the environment. This report has been prepared in accordance with current standards of professional practice. No other warranty is expressed or implied.

William G. Kardos, R.G. No. 620
Principal Geologist

Carey Austrins
Project Geologist

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APPENDICES

AKC	Anti-Knock Compound
AOPC	Area of Potential Concern
bgs	Below Ground Surface
CCR	Current Conditions Report
CFC	Chlorofluorocarbon
cis-1,2-DCE	cis-1,2-Dichloroethene
COI	Constituent of Interest
COPC	Constituent of Potential Concern
COPEC	Constituent of Potential Ecological Concern
CPT	Cone Penetrometer Test
CSM	Conceptual Site Model
CT	Carbon Tetrachloride
CVRWQCB	Central Valley Regional Water Quality Control Board
1,2-DBA	1,2-Dibromoethane
1,2-DCA	1,2-Dichloroethane
DCM	Dichloromethane (Methylene chloride)
DEDML	Diethyl Dimethyl Lead
DNAPL	Dense Non-aqueous Phase Liquids
DOHS	Department of Health Services
DQO	Data Quality Objectives
DTSC	Department of Toxic Substances Control
EDR	Environmental Data Resources, Inc.
EEPA	Ecological Exposure Pathways Analysis
EVS	Environmental Visualization System
$FeCl_2$	Ferrous Chloride
$FeCl_3$	Ferric Chloride
GAC	Granular Activated Carbon
gpm	Gallons Per Minute
GPS	Global Positioning System
GWMP	Groundwater Monitoring Plan
GWTF	Groundwater Treatment Facility
HCFC	Hydrochlorofluorocarbon
HCl	Hydrochloric Acid
HF	Hydrofluoric Acid
HSWA	Hazardous and Solid Waste Amendments
MCL	Maximum Concentration Limit

mg/L	Milligrams Per Liter
MSL	Mean Sea Level
MIP	Membrane Interface Probe
mllw	Mean Lower Low Water
NPDES	National Pollutant Discharge Elimination System
ORP	Oxidation-Reduction Potential
PCB	Polychlorinated Biphenyl
PCE	Perchloroethene (Tetrachloroethene)
ppt	Parts Per Trillion
PQL	Practical Quantitation Limits
PRB	Permeable Reactive Barrier
PRG	Preliminary Remediation Goals
RBSC	Risk-Based Screening Criteria
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposed
SP	Spontaneous Potential
SWMU	Solid Waste Management Unit
TAF	Thousand Acre-Feet
TCM	Trichloromethane (Chloroform)
TDS	Total Dissolved Solids
TEL	Tetraethyl Lead
TEQ	Toxicity Equivalency Factors
$TiCl_4$	Titanium Tetrachloride
TiO_2	Titanium Dioxide
TML	Tetramethyl Lead
ug/L	Micrograms Per Liter
USEPA	United States Environmental Protection Agency
UST	Underground Storage Tank
VOC	Volatile Organic Compound
WDW	Waste Disposal Well
WHO	World Health Organization
ZVI	Zero Valent Iron

1.0 INTRODUCTION

From 1955 to 1999, E.I. du Pont de Nemours and Company (DuPont) operated a chemical manufacturing facility in Antioch, California that was referred to as the Antioch Plant (see Figure 1-1). Since then, manufacturing operations have been shut down and the structures have been removed. The facility is now referred to as the DuPont Oakley Site to differentiate it from the former active manufacturing facility and to recognize its recent incorporation within the boundaries of the city of Oakley. The site is undergoing investigation and remediation activity under the Resource Conservation and Recovery Act (RCRA), with the eventual goal of redeveloping the site as a business park, including commercial office and retail uses. The site has been designated as a "Jobs Opportunity Zone" as part of a smart growth initiative passed by the California State Legislature.

The Central Valley Regional Water Quality Control Board (CVRWQCB) regulated the environmental program at the site until March 2002, when the CalEPA Site Designation Committee identified the Department of Toxic Substances Control (DTSC) as the lead agency in response to a request by DuPont. This *Current Conditions Report* (CCR) is designed to document DuPont's site characterization efforts, to identify potential data gaps, and to establish a common understanding between DuPont and the DTSC of the geology, hydrogeology, and contaminant distribution at the site.

Operations at the Antioch Plant began in 1956. Production of fuel-additive anti-knock compounds (AKCs) and chlorofluorocarbons (CFCs) began in 1956, while titanium dioxide (TiO_2) production was added in 1963. Production of all three product lines has been eliminated, beginning with AKC manufacturing in 1981, CFC manufacturing in 1996, and TiO_2 manufacturing in July 1998, followed by a general shutdown of all TiO_2 and CFC blending operations on March 31, 1999. Currently at the site, but unrelated to previous manufacturing, is a DuPont Performance Coatings warehouse and distribution center.

1.1 Purpose

The primary purpose of the CCR is to summarize work performed by DuPont to date for characterizing the site constituents of potential concern (COPCs) distribution in surrounding media. DuPont has been investigating the site since the early 1980s and has developed an extensive database containing information about potential releases, source areas, and COPC distribution. Media investigated include groundwater, soil, soil gas, indoor air, and surface water. Details of the various investigation programs, their findings, and recommendations are contained within this report. This report also documents available site knowledge by medium and identifies any remaining data gaps that should be addressed to further enhance site understanding. Information contained in the report will provide a basis for completion of corrective action at the Oakley site, enabling future site redevelopment.

In addition to the investigation program at the site, DuPont has undertaken a number of remedial measures to address soil and groundwater contamination. Six surface impoundments were backfilled and closed after excavation and offsite disposal of waste materials and contaminated soils. A groundwater pump and treat system was installed at the site in 1990 and operated until 2001, when a more promising groundwater remedial alternative, a permeable reactive barrier or PRB, was constructed as part of an innovative technology demonstration. A final PRB evaluation and recommendation is scheduled for completion in 2003.

A second purpose of this report is to develop a common understanding between DuPont and the DTSC of the geologic and hydrogeologic conceptual site model (CSM). The site hydrogeologic system is complex with multiple aquifers, thin confining units between aquifers, complex interactions between groundwater and surface water, and multiple potential source areas. DuPont has developed a three-dimensional Environmental Visualization System (EVS) geologic model of the site that is presented in Section 3.0.

During the previous period of active manufacturing, the primary focus of DuPont's corrective action program was contaminated groundwater beneath the surface of the site. Now that the manufacturing facilities have been demolished and removed, DuPont is directing additional resources to investigation and remediation of surface soils to support site redevelopment in accordance with the City of Oakley's General Plan. Groundwater will continue to be addressed on a site-wide basis with the focus on stabilizing groundwater contaminant plumes. Soils will be addressed separately, with regulatory requirements [i.e., RCRA Facility Investigation (RFI)] and redevelopment needs as the focus.

To facilitate future investigation and remediation of aboveground property, discussions between DuPont and the DTSC have led to a recommendation that site soils be divided into six separate areas as listed below (see Figure 1-2):

- Cline Property – divested 2000
- Big Break Marina – divested 2002
- Western and Eastern Development Areas – currently owned by DuPont; unrelated to former manufacturing
- Northern Development Area – currently owned by DuPont; related to former manufacturing
- Southern Development Area – currently owned by DuPont; related to former manufacturing
- Site Wetlands – currently owned by DuPont; unrelated to former manufacturing

Releases to soil, soil gas, and sediment are therefore addressed in this report according to these same property divisions.

The Cline property and the Big Break Marina property were never used for manufacturing purposes. The Cline property has been continuously operated as a vineyard, both during and subsequent to the time of DuPont ownership. Similarly, Big Break Marina has been continuously operated as a marina, both during and subsequent to the time of DuPont ownership. Phase I and II Environmental Site Assessments and other supporting information was previously submitted to the DTSC for these properties, which will therefore not be discussed further in this report.

There are a number of Solid Waste Management Units (SWMUs), RCRA-regulated units, and areas of potential concern (AOPCs) at the site whose status will be clarified in this report. In light of the redevelopment focus at the site, the status of the SWMUs, RCRA-regulated units, and additional AOPCs will be reviewed and datagaps will be identified. The CCR will be used to document RFI data collected to date and to outline the manner in which the RFI should be completed (Phase I Soil RFI, Groundwater RFI). Significant work completed (summarized herein), taken together with original reports, substantially fulfills many RFI data collection and reporting requirements.

1.2 Organization of Report

This document, the *CCR,* is a comprehensive summary of site information that will form the basis for preparation of the *Phase I Soil RFI Workplan* and a *Supplemental Groundwater RFI Workplan*. The *CCR* contains a facility description and regulatory history as well as a summary of investigation reports and data summary tables (Section 2.0). A discussion of site hydrogeology and environmental setting is included in Section 3.0, while data and information relating to preliminary assessments, investigations of various media, and interim measures that have been performed are contained primarily within Sections 4.0 and 5.0. Section 6.0 contains the conceptual site exposure model for human health and an exposure pathway evaluation for ecological receptors. Conservative screening criteria are identified for each medium and receptor as appropriate. The maximum COPC concentrations are then compared to these criteria to screen out COPCs that are not of concern and focus future evaluations and data gathering on the remaining COPCs. It should be noted that in the absence of appropriate background data, detected inorganic elements are considered Constituents of Interest (COI) rather than COPCs. To maintain simplicity and clarity for this report, inorganic elements are referred to as COPCs, with the understanding that until a background evaluation is conducted they are technically COIs. COPCs are identified for each Development Area for human health, and for each habitat area for ecological receptors. Section 7.0 details remedial actions undertaken at the site, their current status, and recommendations for filling datagaps necessary to provide a basis for future corrective action decision-making. Section 8.0 contains a listing of identified datagaps in the corrective action program at the Oakley site and a recommended pathforward for filling the identified datagaps.

DTSC comments on the annotated outline for the CCR are contained in Appendix 1-1 with notations to indicate where the comments are addressed within the body of the CCR.

2.0 SITE DESCRIPTION

2.1 Facility Description

The DuPont Oakley site is located in Contra Costa County at 6000 Bridgehead Road, in Oakley, California. The site is located adjacent to the San Joaquin River and the San Joaquin Delta area, approximately 40 miles east of the City of San Francisco and approximately 60 miles southwest of the City of Sacramento adjacent to State Route 160. Current acreage at the site is approximately 368 acres, of which more than 132 acres are wetlands and 63 acres are non-manufacturing areas such as parking lots, vineyards, and administrative facilities (see Figure 2-1). The remaining portions of the site were used for manufacturing and manufacturing support activities. The original plant property (owned by DuPont at the time a RCRA Part A Permit application was submitted) is shown by the red line in Figure 2-1. The boundaries at that time were defined as follows:

- Eastern Boundary: Big Break Marina and Big Break Road
- Southern Boundary: Highway 4
- Western Boundary: Bridgehead Road
- Northern Boundary: Lauritzen Yacht Harbor and the San Joaquin River

DuPont purchased Big Break Marina in 1987 and sold it in 2002. The vineyards located south of the Santa Fe/Burlington Northern Railroad, east of the TiO_2 Manufacturing Area (see Figures 2-1 and 2-2), and south of the Little Break wetlands were sold to Cline Vineyards in 2000. Current site boundaries are indicated by the white line in Figure 2-1 and are as follows:

- Eastern Boundary: Big Break Marina and Cline Vineyard property
- Southern Boundary: Santa Fe/Burlington Northern Railroad and the PG&E pumping station
- Western Boundary: Bridgehead Road
- Northern Boundary: Lauritzen Yacht Harbor and the San Joaquin River

Surrounding Land Use

Land use surrounding the site is varied, with the predominant use along the northern and eastern boundaries of the site being recreational marina operations. The Cline Vineyard property to the south and east operate as a commercial vineyard operation (see Figure 2-2). The main use along the western boundary could be characterized as light industrial primarily consisting of support facilities for the Antioch Bridge toll plaza and Caltrans.

Two Environmental Data Resources, Inc. (EDR) searches were performed for this report: one to identify wells within a one-mile radius of the site boundary and one to identify underground storage tanks (USTs) within a one-mile radius of the site. These reports are contained in Appendix 2-1. Findings from the well search identified six listed wells within the search zone, all of which are upgradient or cross-gradient to site manufacturing areas and contaminated groundwater. Wells 3 and 4 are located along Highway 4 due south of the site. In the report, their use is identified as irrigation wells. Wells 1 and 2 are identified as potential municipal wells and are located south and west of the site.

An additional request for information on area wells was made to the California Department of Water Resources (DWR). A number of water wells and monitoring well logs were supplied and reviewed. The review indicated geology similar to site geology and that no drinking water wells were located in proximity to site contamination or in the flow path of site groundwater contaminant plumes. Because California law stipulates that these logs are confidential, they were sent under separate cover to the DTSC where they can be reviewed upon request.

The UST tank records search identified 15 USTs within a one-mile radius of the site including two USTs downgradient of the site and one at New Bridge Marina (on the west side of the Antioch Bridge) and one at Lauritzen Yacht Harbor. The location shown on the map for the New Bridge and Driftwood Marinas UST (#6) is not consistent with the physical location of New Bridge/Driftwood Marina. Two USTs were located on DuPont property (5, 11), one on the main plant property (5), and one at Big Break Marina (11). Both of these USTs are now closed. Four additional USTs are located upgradient to portions of the site (4, 7, 12, and 13). No information is available on the status of USTs 7 and 13. For USTs 4 and 12, the EDR report notes that the aquifer was affected but does not indicate closure dates. The remaining USTs are located further from the site in cross-gradient directions and would not have the potential to affect site groundwater.

Appendix 2-2 contains the Annual Water Quality Report 2001 for the Contra Costa Water District, a district that includes the cities of Antioch, Martinez, Pittsburg, and Oakley. This report states that the primary source of drinking water in the district is surface water from the Sacramento – San Joaquin Delta. The district draws delta water from Rock Slough near Oakley and distributes this water to the various municipalities.

The topography of the land within the current DuPont property can be discerned in Figure 2-3. This topographic map for the site was developed using aerial photogrammetry techniques. In general, the land surface slopes from south to north, ranging in elevation from 25 feet above sea level along the southern boundary to near sea level at the river's edge.

Site Land Use

Land use patterns at the site are depicted in Figure 2-2. The portions of the site shown in yellow on Figure 2-2 were covered with wetlands when DuPont purchased the property and have been maintained as natural wetland areas. The portions of the site shown in light blue were planted in vineyards at the time of DuPont's purchase and have been maintained as vineyards during DuPont operations, and subsequent to DuPont operations for the property purchased by Cline. The vineyard parcel in the northwest corner of the site has been removed, allowed to lay fallow, with periodic discing for weed control.

Administrative offices and parking lots are shown in black outline on Figure 2-2. This area was used primarily as the site entrance, main parking area, and as the site administrative offices. Manufacturing support areas are shown in white with blue stippling on Figure 2-2. These areas consisted of maintenance shops, the RCRA storage building, and other miscellaneous areas related to manufacturing.

The CFC Manufacturing Area is shown in white outline, the AKC Manufacturing Area is shown in orange outline, while the TiO_2 Manufacturing Area is shown in dark blue outline. The surface impoundments that were part of the plant's wastewater treatment system are shown in purple on Figure 2-2.

Currently, there are few intact structures at the site. The intact structures include the administrative office building, the RCRA storage building, the DuPont-Kansai Automotive Paint warehouse, a storage building near the old groundwater treatment facility (GWTF), and a storage building just east of the DuPont Kansai warehouse. All other structures were demolished down to ground level, with foundations and below ground facilities left in place, with the exception of the 500,000-gallon water tank and the fire pump house.

The locations of key roads, buildings, and other site infrastructure are indicated in Figure 2-4.

2.2 Owner/Operator History

Operations at the Oakley site began in 1955. Production of AKCs and CFCs began in 1957, while TiO_2 production was added in 1963. The production of all three of these product lines were eliminated, beginning with AKC manufacturing in 1981, CFC manufacturing in 1996, and TiO_2 manufacturing in July 1998, followed by a general shutdown of all TiO_2 and CFC manufacturing and blending operations on November 30, 1999. Currently at the site, but unrelated to previous manufacturing, are a DuPont Performance Coatings warehouse and distribution center.

2.3 Facility Processes and Waste Management

2.3.1 CFC Manufacturing and Waste Management

DuPont produced CFC products under the trade name Freon® from 1957 until 1996, after which CFC blending operations continued until plant shutdown in 1999. Upon shutdown, the CFC manufacturing facility was dismantled down to ground level, leaving in place building footings, trenches, sumps, etc. The following subsections describe how CFCs were manufactured and how wastes were generated, treated, and disposed. The CFC Manufacturing Area is shown in white outline in Figure 2-2.

CFC Manufacturing

Freon® brands that were manufactured at the site included trichlorofluoromethane (Freon® 11, CFC-11), dichlorodifluoromethane (Freon® 12, CFC-12), and chlorodifluoromethane [Freon® 22, hydrochlorofluorocarbon (HCFC-22)]. Although it was never manufactured at the site, 1,1,2-trichlorotrifluoroethane (Freon® 113, CFC-113) was brought on-site and blended with other compounds (such as acetone, methylene chloride, ethanol, nitromethane, isopropanol, or methanol) to produce specific Freon® products.

CFC products were manufactured by heating hydrofluoric acid (HF) and carbon tetrachloride (CT) to boiling in the presence of a charged-antimony-containing catalyst ($SbCl_5$). The basic reaction produced CFC-11 and CFC-12 with HCFC-22 and CFC-112 as byproducts. CFC-11 and CFC-12 were separated from the product stream by a water scrubber which removed residual CT, HF, HCFC-22, and CFC-112. The process included further separation of CFC-11 and CFC-12 products, and an additional column was added to the CFC-11 line to remove residual CT impurities. A recovery system was also used to remove HCFC-22 from the waste stream.

The HF was delivered by railcars to the CFC Railcar Loading/Unloading Area (Figure 2-4), unloaded and stored in the HF Tank. In the early 1980s a containment system was installed in the area to control potential HF spills. HF was only used as a raw material and was never manufactured at the site.

CFC Waste Streams

Primary wastes generated in CFC production included hydrochloric acid (HCl) and unreacted HF. The HF was recovered and recycled to the reactor for further reaction. The generated HCl was recovered, purified, and sold as a separate product. Approximately one-half pound of HCl was generated for every pound of CFC produced. The HCl fume scrubber, used to purify the HCl, removed impurities from this by-product stream and discharged them to the waste tank. Additional wastes generated by the reaction included the spent antimony catalysts, unreacted CT, unreacted HF, fluoride, tetrachloroethene (PCE), CFC-12 and CFC-112. Fluorospar (CaF_2)tended to accumulate in the antimony catalysts and would have contributed arsenic to the waste stream. Off-spec CFC-113 blended products may also have contributed to the waste streams generated in the CFC Manufacturing Area.

CFC Waste Management Units

All waste streams and upsets from the CFC production process were transported to the East, West, or Emergency Basin via the B Avenue Trench system. The B Avenue Trench was part of a system of wood-lined trenches that carried wastes and runoff from the various operating areas of the plant to the disposal basins.

The basins were surface impoundments built in the early 1960s for disposal of the various wastewater streams generated by the manufacturing facilities. The East and West Basins were lined with clay and the Emergency Basin was excavated into the marsh deposits that form the Upper-Surficial confining unit. Wastes from all three processes (CFC, anti-knocks, and pigments production) ultimately discharged to the river through this system. The East and West Basins discharged directly to the river through a permitted National Pollutant Discharge Elimination System (NPDES) outfall operated in accordance with State and Federal regulations. The Emergency Basin was a holding area for concentrated process upsets, which were then incrementally blended with other wastewater streams to reduce concentration limits to acceptable levels before discharge through the outfall. The three basins were closed under an approved closure plan.

SWMUs, RCRA-regulated units, and AOPCs for this manufacturing area will be clarified in Section 4.0.

CFC Waste Treatment and Disposal

The constituents associated with CFC manufacturing were discharged to the East, West, and Emergency Basins as part of normal operation of the process wastewater system at the site. The HF waste was neutralized at pH trim stations along B Avenue Trench and then later flowed over beds of limestone gravel. CFC waste streams and waste streams for the power house, sanitary facilities and other miscellaneous sources also flowed to the basin disposal system via the B Avenue Trench.

Reaction catalysts that were used in the process were emptied into a wooden tank and then slowly diluted into the B Avenue Trench for neutralization at the pH trim stations and limestone beds. The liquid was ultimately discharged to the East, West and Emergency Basin system for final disposal. During process upsets at the site, CFCs were routed through the B Avenue Trench into the East, West, Emergency Basin system.

COPCs associated with the CFC Manufacturing Area include various VOCs (i.e., acetone, methylene chloride, CT, PCE, CFC-11, CFC-12, CFC-113) and inorganic elements (i.e., antimony, arsenic, and fluoride).

2.3.2 AKC Manufacturing and Waste Management

Tetraalkyl lead anti-knock gasoline additives, hereafter referred to as organo lead, were manufactured at the site from 1957 through 1981. The various organo lead species produced at Oakley included tetraethyl lead (TEL), tetramethyl lead (TML), and diethyldimethyl lead (DEDML). Blending, packaging, and distributing continued through 1986. The following subsections describe how the organo lead was manufactured and how wastes were generated, treated and disposed. The location of the AKC Manufacturing Area is shown on Figure 2-2.

AKC Manufacturing

The organo lead was manufactured by first mixing molten lead and molten sodium. The alloy was then reacted with chloroethane (or chloromethane) in the presence of a catalyst (both acetone based and fluoride based catalysts were used) to produce the organo lead. Catalysts were replaced periodically and the spent catalyst was mixed into the waste stream and routed to the disposal basins for treatment.

After the initial reaction, the organo lead product stream was sent to a draw-off tank to quench the reaction and cool the process stream. The reaction mass was continuously released from the draw-off tank into a cyclone stripper where pressurized steam and sodium dichromate were used to separate vapor phase organo lead product (and other product gases) from the wastewater stream containing sodium chloride by-products, partially reacted dissolved lead species, and unreacted lead solids. The sodium dichromate facilitated organo lead evaporation and separation from the lead solids. Lead solids were separated from the wastewater stream then dewatered and conveyed to the containers of molten lead. The lead pots were covered with a layer of caustic substance to purify the lead. The lead was then recycled to the alloy reactor and mixed with molten sodium to form additional sodium-lead alloy.

The organo lead product was then separated from the product stream by distillation. Because the organo lead was very unstable, it was mixed with 1,2-dichloroethane (1,2-DCA), 1,2-dibromoethane (1,2-DBA), and kerosene to produce the final product.

All equipment decontamination and repair for AKC processes occurred in Bldg. 48 (see Figure 2-4). Potassium permanganate was used to decontaminate equipment to oxidize organic lead to elemental lead. During routine process maintenance, sodium sulfide was flushed through the lines and vessels to coat and deactivate bismuth scales that formed in the process lines. This procedure took place every two weeks.

AKC Waste Streams

The organo lead reaction process produced a wastewater stream containing sodium chloride, sodium hydroxide, unrecovered organo lead, dissolved lead species, and inorganic lead. Spent catalysts may also have been discharged with the wastewater stream. All wastewater streams were treated in Bldg. 41.

The wastewater treatment process generated a waste sludge that was discharged into a holding tank and initially sent off-site for disposal. Later process modifications included both organic and inorganic lead recovery from the sludges, and the resulting pelletized solid waste was sold to secondary lead smelters.

The AKC process also produced a nitrogen-based waste gas stream that may have contained unrecovered organo lead, unrecovered chloroethane, and ethane. The waste gases were purified and injected into the deepwell [waste disposal well (WDW) No. 1] for disposal.

AKC Waste Management Units

Wastes from the production of AKC were processed and handled by a system that consisted of three major waste management units: 1) treatment and separation units, 2) the trench system, and 3) the East, West, and Emergency Basins.

Originally, the AKC wastewater stream was routed to the East, West, and Emergency Basins following treatment in Building 41, where a clarifier removed the solids and the sludges from the waste stream. Beginning in the early 1970s, sludge wastes from the clarifier were routed to Ponds A, B, and C on the east side of the site to separate the solids from the water via settling. The separated water was then re-routed back to Building 41 for final polishing prior to discharge to the East, West, and Emergency Basins via the B Avenue Trench.

Ponds A, B, and C were used to settle out the solids from the sludges generated by the wastewater clarification process. These ponds were lined with concrete slabs connected by rubber gaskets and were coated with a layer of gunite. Gunite is a mixture of cement, sand, and water. Discussions with former plant personnel suggest that cracks were observed in the gunite in all ponds during routine maintenance and a small hole was found in the gunite in Pond B. During the 1984 closure of the lead ponds, A, B, and C Ponds were dredged to remove all solids. In addition to a floating dredge, a farm tractor equipped with a scoop and vacuum system was used to complete the removal of solids from the concrete ponds. No "potholes" or dislodged pieces of concrete flooring were encountered.

The 1,2-DCA and 1,2-DBA that were used to stabilize the organo lead product were stored in tanks in the central portion of the plant to the north of the AKC Manufacturing Area. The 1,2-DCA tank sat directly on the ground and was surrounded by an earthen berm. Recent discussions with former plant personnel indicate that the 1,2-DCA tank suffered damage and subsequent repair on several occasions. The 1,2-DBA tank was elevated above the ground and no damage to this tank was recalled.

Other potential sources/management areas for waste streams included the sludge washer effluent, sodium dichromate sump, filtrate bin overflow, recovered water tank overflow, aerator decantor overflow, fume scrubber, caustic melt pot eductor, sludge waste pad, flash purifier decantor overflow, decontamination pad, and blender clean-up.

SWMUs, RCRA-regulated units, and AOPCs for the AKC Manufacturing Area will be discussed in detail in Section 4.0.

AKC Waste Treatment and Disposal

Prior to discharging to the waste disposal trench system, the AKC wastewater stream was treated in Building 41 (Trade Waste). Treatment processes included settling, coagulation, clarification, filtration, and pH adjustment. The sodium hydroxide-rich wastewater stream from the condenser routed to a clarifier, where pH was adjusted to 9 by adding either HCl or sulfuric acid to minimize lead solubility and precipitate out lead solids. Sodium borohydrite was added to aid removal of dissolved lead species. A flocculent [such as ferric chloride ($FeCl_3$)] may have been added to facilitate the settling of solids. The clarified wastewater was neutralized with HCl and was filtered. This filtrate was injected into the deepwell disposal well (WDW No. 1) at a depth of 6,480 feet to 6,650 feet below mean sea level. Wastes were injected at 2020 psi with a final volume of 39 million gallons injected through March 1958. In 1958 it was determined that the treated wastewater was suitable for disposal through the basin system.

In 1969, the deepwell was re-completed up-hole with perforations from 5,960 to 6,335 feet below mean sea level. The lower zone, previously used for wastewater disposal, was sealed off with a bridge plug at 6,482 feet below mean sea level. The purpose of the modification was for disposal of the waste gas stream generated during the distillation process that separated the organo lead product and chloroethane gas streams from the remaining off-gases. Waste gas injection commenced in 1970 and continued until 1981. Gases injected into this interval included: compressed ethane, chloroethane, butane, nitrogen, hydrogen, and may have included lead. Injection quantities averaged 15 million pounds per year at pressures of 1700 psi for an estimated total of 167 million pounds. The well was closed and abandoned in April 1982.

The waste lead sludge from the clarification process was initially discharged into a holding tank and then sent off-site for disposal. In the 1970s, DuPont discontinued shipping the sludge off-site and began to separate the sludge solids from the wastewater using retention ponds A, B, and C. The solids were periodically dredged from the ponds and sent to Building 50 to recover inorganic lead and organo lead. This operation incorporated a thermal process that recovered and purified the organo lead for re-use in product blending. The remaining inorganic lead sludge was converted into a stabilized pelletized lead product that was sold to lead refiners for production of metallic lead.

During system upsets, spills or process overflows were collected by trenches located throughout the AKC Manufacturing Areas. The trenches contained traps to capture organo lead via gravity separation. The trenches ultimately drained to the blender sump, which discharged to the B Avenue Trench for routing to the disposal basin system.

COPCs for the AKC Manufacturing Area include chloroethane, acetone, 1,2-DCA 1,2-DBA, organo lead, kerosene, inorganic lead, and chromium.

2.3.3 TiO_2 Manufacturing and Waste Management

TiO_2 production began in 1963 and ended in 1998. The location of the TiO_2 Manufacturing Area is shown in Figure 2-2. TiO_2 is an inert pigment primarily used in paints, paper, and plastics, and is produced by reacting the mineral rutile, removing impurities, and oxidizing to TiO_2, a very fine pure white powder. This reaction was accomplished by mixing coke and ore and reacting with chlorine gas at temperatures greater than 1,000 degrees centigrade. This chlorination process produces $TiCl_4$ plus other metal chlorides [ferrous chloride ($FeCl_2$), $FeCl_3$, etc.] in gas phase. $TiCl_4$ was then separated from the other metal chlorides and oxidized to form TiO_2.

Prior to the early 1980s, byproduct metal salts were solidified as they cooled and disposed in an off-site landfill. After that time, this inert byproduct was mixed with Portland cement and water to form Sierra Crete™, a material used as a road base. The recent identification of trace levels of dioxins in Sierra Crete™ will necessitate adding this class of compounds to the list of analytes to be investigated at pertinent TiO_2 Manufacturing Area SWMUs.

TiO_2 Manufacturing

The manufacture of TiO_2 at the Oakley site utilized the continuous chloride process. This process consisted of four stages of production: reaction, purification, oxidation and finishing.

In the reaction process, the titanium bearing ores were reacted with chlorine in the presence of coke at high temperatures to produce titanium tetrachloride ($TiCl_4$). Coke provided fuel as well as a reducing environment to consume any excess oxygen. The chlorination step produced the $TiCl_4$ as well as other metal chlorides in a gas phase.

The purification phase utilized a spray condenser to remove iron and other metal chloride impurities. The vaporized reaction products were first partially condensed to remove most of the heavy metal chloride impurities. The $TiCl_4$ vapor containing trace impurities was then totally condensed. The remaining impurities were removed by chemical treatment and distillation.

During the oxidation process, pure $TiCl_4$ was oxidized to TiO_2 at high temperature with pure oxygen. The chlorine gas liberated during oxidation was recycled to the chlorinator after separation from the TiO_2 product.

Finally, in the finishing phase, the TiO_2 was chemically treated to impart the desired optical and physical properties required for specific end uses. The pigments were ground to a specific particle size, then packed in shipping containers.

TiO_2 Waste Streams

The reaction, purification and oxidation process produced two primary waste streams. One waste stream was composed of ferric chloride ($FeCl_3$) solids and other metal chloride compounds. The $FeCl_3$ solid wastes were pretreated and sent off-site for disposal until the early 1980s, after which they were mixed with Portland cement to create Sierra Crete™, a product that was sold commercially for use as a road base material. The second process waste stream, wastewater, was separated from the solid waste stream and was coagulated with $FeCl_3$ or alum, neutralized, and flocculated with an organic polyelectrolyte. The wastewater stream was routed to the white pigments retention ponds where it was pH adjusted and residual solids were allowed to settle out. The separated water was then discharged to the TiO_2 trench.

Other waste streams associated with the production of TiO_2 were not byproducts of the process, but were generated during routine maintenance and process interruptions. During shutdowns between 1965 and 1967, CT was pumped through the process lines to clean the system; therefore, it was possible for CT to be present in the waste stream. Similarly, PCE was flushed through the process system to quench reactions, clear lines, and to clear system units. Any maintenance event would have required PCE to be flushed through the system; therefore, PCE was included in the waste stream and was even observed in the TiO_2 trenches at times. The PCE in the TiO_2 trenches was likely attributed to the practice of washing out vessels after PCE was flushed through the system.

TiO_2 Waste Management Units

The primary facilities used to manage wastes from the TiO_2 manufacturing area include the white pigment retention ponds, the TiO_2 and East Trenches, and the East, West, and Emergency Basins.

The ponds received treated wastewater streams from process units, storm water and process overflow for solids removal and pH adjustments (using either sodium hydroxide or sulfuric acid) prior to entering the D Avenue trench for transport to the Holding Pond (formerly West Basin) for eventual discharge to the San Joaquin River via the plant NPDES outfall. Prior to use of the Holding Pond, this wastewater discharged to the East, West, and Emergency Basins. Settled solids from the retention ponds were routinely dredged. This dredge spoil material was used as fill material in the area north of the Northern Retention Pond and in the TiO_2 Landfill south of the TiO_2 Manufacturing Area.

SWMUs, RCRA-regulated units, and AOPCs for the TiO_2 Manufacturing Area will be discussed in detail in Section 4.0.

TiO_2 Waste Disposal and Treatment

The solid wastes containing $FeCl_3$ were allowed to cool and were pH adjusted prior to disposal in an off-site landfill. This practice continued until the early 1980s. After the off-site shipment ceased, this byproduct was mixed with Portland cement and limestone to form Sierra Crete™, a material used as a road base. The process was centered southwest of the Ore Storage Building (Figure 2-4). Sierra Crete™ was used for spot paving on-site and on sections of the 5th and 6th Streets' parking lot in the vineyard. A test road constructed of Sierra Crete™ was also installed on-site in 1988. The locations of these roads is discussed in further detail in Sections 4.0 and 5.0.

Residual solids that settled out in the retention ponds were dredged and disposed of at an on-site landfill. The ponds were dredged in alternate years, with the dredge spoil placed in the Pigments Evaporation Basin (north of the Retention Ponds) until the mid-1980s, after which it was placed in the TiO_2 Landfill. The landfill was located south of the TiO_2 Manufacturing Area and north of the railroad tracks.

The wastewater that remained after the solids settled out of the white pigments retention ponds was adjusted for pH prior to discharge to the TiO_2 trench and ultimately to the disposal basin system. Sodium hydroxide, which was used to neutralize acidic TiO_2 process streams, resulted in the addition of dissolved sodium and chloride in the waste streams.

PCE and the products of its decomposition are the primary COPCs in groundwater contaminated as a result of TiO_2 manufacturing operations. Based on process knowledge and previous soil sampling (such as that performed near the Iron Chloride Storage Tank Area discussed further in Section 5.1.3) COPCs also include iron, manganese, cobalt, copper, nickel, barium, chromium, thallium, vanadium, inorganic lead, hexachlorobenzene, pentachlorobenzene, and PCBs. Additional COPCs in soils may include dioxins and furans..

2.4 Regulatory History

The Oakley site's USEPA I. D. Number is: CAD005191671

Notification of Hazardous Waste Activity was submitted to the USEPA on July 23, 1980.

The types of hazardous waste activities noted were:

- Generation
- Treatment, Storage, and Disposal
- Underground Injection

Following this notification, a RCRA Part A Permit Application was submitted on November 6, 1980.

This Part A Application identified the following processes at the facility:

- Container Storage
- Surface Impoundment
- Chemical Treatment

Treated effluent was discharged to the San Joaquin River via a NPDES-permitted outfall (NPDES No. CA0004936.)

In a May 8, 1985 letter, the United States Environmental Protection Agency (USEPA) requested part B of the RCRA application for a hazardous waste facility permit. The letter stated: "This part B request extends to your facility's hazardous waste activities in landfill, surface impoundment, land treatment and waste pile units. Other process units (container and tank storage and treatment) are now regulated by the California Department of Health Services (DOHS) except for areas covered by the new HSWA requirements."

At this point, there were only closed surface impoundment units at the plant that were subject to the Part B request. This was communicated in a letter to USEPA on July 25, 1985.

In a December 13, 1985 letter USEPA:

1. Requested confirmation that each surface impoundment unit ceased accepting hazardous waste on or before November 8, 1985.
2. Wanted to know whether any unit that lost interim status on November 8, 1985 is now accepting non-RCRA waste.
3. Requested information on how waste introduced in these units before November 8th is now being managed, and the annual amount of waste that was previously managed in these units.

The information was provided to USEPA in a December 19, 1985 letter resulting in agreement from USEPA that no Part B Permit Application was required.

In addition to the permitting and negotiations over the Part B permit with USEPA, DuPont submitted a hazardous waste activities questionnaire to the DOHS on May 29, 1981.

Following this, a Hazardous Waste Facility Permit application together with an Operation Plan and a completed Industrial Waste Survey Form was submitted on July 1, 1981. The State issued the Interim Status Document on November 12, 1981. DuPont submitted a groundwater assessment plan to the CVRWQCB in 1983 to address soil and groundwater contamination at the site. As a result of investigation activities, a groundwater recovery and treatment system was installed in 1991, in an effort to contain groundwater contamination on site. Several areas of soil contamination were excavated, with contaminated soil disposed of off-site.

In 1987, A. T. Kearney and Science Applications International, under contract to USEPA Region IX, performed a RCRA Facility Assessment (RFA) at the site. In 1993 the DTSC, under agreement with the USEPA, re-issued the 1987 RFA with comments, incorporating the results of DTSC's visual site inspection (VSI) performed during 1992.

The NPDES permit No. CA0004936 was recinded by Order #5-01-137 on June 14, 2001, due to changes in facility opearations. A General Permit notice of intent was submitted on August 30, 2001 by DuPont and was subsequently approved by order 97-03-DWQ under CAS000001.

2.5 Investigation History

Numerous investigations have been undertaken at the Oakley facility with samples collected from groundwater, soil, surface water, and soil gas. The chronology and focus for these investigations is shown in Table 2-1.

2.5.1 Soil Investigations

Further details on the locations of SWMUs and AOCs identified below are presented in Section 4.

RFA (September 18, 1987)

- Conducted by A.T. Kearney and Associates
- Identified already closed units as:
  - East Basin (SWMU 4.1)

- West Basin (SWMU 4.2)
- Emergency Basin (SWMU 4.3)
- TEL Ponds A, B, and C (SWMUs 4.4 through 4.6)
- Acid Digester (SWMU 4.32)
- Deep Injection Well (SWMU 4.33)

❑ Identified a total of 36 SWMUs and 17 potential SWMUs and/or AOCs

RFA Supplement (April 1993)

❑ Based on 1987 RFA by A.T. Kearney and Associates, supplemented with information from two visual site inspections conducted by the DTSC in 1992

❑ Identified 38 SWMUs, of which six (East, West, and Emergency Basins and TEL Ponds A, B, and C) had been closed

❑ An additional five RCRA-regulated units, in Interim Status at the time of the RFA, were undergoing closure. These were:

- SWMU 2.17 – Spent Solvent Railcar Area
- SWMU 2.18 – Fluoride Tank Unit
- SWMU 4.26 – Acid Metal Chloride Waste Tank
- SWMU 4.29 – Old Container Storage Area
- SWMU 4.37 – Secondary Containment Pond

❑ Recommended no further action for the following SWMUs:

- SWMU 4.19 – South Retention Pond
- SWMU 4.20 – North Retention Pond
- SWMU 4.21 – South Containment Pond
- SWMU 4.22 – North Containment Pond
- SWMU 4.27 – Temporary Storage Area for TiO_2 Waste
- SWMU 4.28 – Laboratory Pigments Sump
- SWMU 4.30 – Portable Antimony Waste Containers
- SWMU 4.32 – Acid Digester Treatment Facility
- SWMU 4.33 – Injection Well
- SWMU 4.34 – TiO_2 Landfill
- SWMU 4.35 – Septic Tanks
- SWMU 4.38 – Container Storage Building

❑ Remaining SWMUs to be carried forward to the RFI

Human Health Multimedia Risk Assessment – Iron Chloride Tank Unit Area (May 2, 1996)

❑ Soil and groundwater samples were collected in the vicinity of the Iron Chloride Unit

❑ A risk assessment for this unit was performed in accordance with Title 22 California Code of Regulations Section 66265.197

❑ Primary constituents of concern were chromium (III), copper, lead, and vanadium

❑ Evaluated incidental ingestion, inhalation of particulates, and direct dermal contact pathways

- As per DTSC *Permit Writer Instructions for Closure of Treatment and Storage Facilities* regulations, verification of alternative clean closure under RCRA for the Iron Chloride Tank Unit has been achieved
- No further action is recommended

Human Health Multimedia Risk Assessment – Fluoride Tank Unit Area (August 18, 1996)

- Soil and groundwater sampling was performed in the vicinity of the fluoride tank unit
- Human health risk assessment was performed using these data
- Primary constituents of concern are arsenic and fluoride. These constituents plus other organic and inorganic constituents were included in the risk assessment
- Concentrations in all areas of the FTU are below the Allowable Receptor Concentrations
- As per DTSC *Permit Writer Instructions for Closure of Treatment and Storage Facilities* regulations, verification of alternative clean closure under RCRA for the Fluoride Tank Unit has been achieved
- No further action recommended

Phase I and II Soil and Groundwater Investigations (July 8, 1997; August 5, 1997)

- Soil and groundwater samples were collected around each SWMU to evaluate if the SWMU had released
- The Phase I investigation focused on AKC-related SWMUs
- The Phase II investigation focused on TiO_2 and CFC-related SWMUs
- Designed to be the equivalent of a Phase I RFI
- Both soil and groundwater samples were collected at each identified SWMU. These were compared to site screening levels, and a determination was made as to whether soils posed a threat to further degrade groundwater
- DuPont recommended no further action for all CFC and TiO_2-related SWMUs
- DuPont concluded that all AKC-related SWMUs had released, with 5 of the 13 investigated requiring additional characterization
    - Those requiring additional characterization were the TEL Blender Trap and Blender Water Diversion Sumps, Building 41 Surge Sump, and the Wood-lined Trench System.

2.5.2 Groundwater Investigations

Groundwater Study Investigations (January 1980)

- Twenty-seven monitoring wells installed (MW-30 through MW-56). Performed electrical logs on MW-30 through MW-33

- Collected geologic information from the Western Delta Salinity Study on Sherman Island (DWR) and from California Department of Transportation (geotechnical logs from Antioch Bridge)
- Groundwater samples collected from the 27 wells installed, from three older wells onsite and from 18 wells outside DuPont property
- Collected water samples from Lauritzen Harbor and from San Joaquin River
- Conducted pump test on MW-55 (this well later renamed to GW-09) at 165 gallons per minute (gpm) for 25 hours. Transmissivity of Lower Aquifer found to be about 19,000 gallons per day per foot near this well
- Report concluded that a plume of saline (NaCl) water from the property was found west, north and east of the holding basins. Migration direction was north towards the San Joaquin River. Estimated that 16,200 pounds of NaCl left the site daily due to plume. Lead found in onsite wells, but not in wells off DuPont property

Evaluation of Extraction and Treatment Alternatives, Phase I Groundwater Remedial Program (November 7, 1986)

Alternatives for extraction and treatment of shallow groundwater containing volatile organic compounds (VOCs) and lead at the Oakley site were evaluated using data collected by consultant Levine-Fricke between March and September 1986 as well as those collected by Woodward-Clyde Consultants (1980) and DuPont (1981-1984).

Efforts for developing an extraction- and treatment-system design were focused on two affected ground-water areas, both of which are in the northern part of the plant. Treatment requirements for water from the two extraction systems differed due to the presence of lead in shallow groundwater and in the GW-04 area. Treatment of groundwater containing only VOCs appeared to be a choice between air stripping with an emission control system on the air stream, and liquid phase adsorption. Groundwater affected with lead and relatively low VOC concentrations could be treated using air stripping followed by activated carbon to remove the lead.

Levine-Fricke recommended alternatives including: (1) extracting lead- and VOC-affected groundwater from a system of shallow (0 to 50 feet deep) wellpoints, and (2) extracting VOC-affected groundwater from a system of deeper (40 to 110 feet deep) wellpoints. This extraction alternative would reportedly provide hydraulic containment of groundwater with the lowest flow rate, approximately 125 gpm.

Evaluation of Groundwater Extraction Alternatives (April 25, 1989)

At the request of DuPont, Levine-Fricke conducted this study to evaluate extraction alternatives to capture and remediate contaminated groundwater at the site. Chemical concentrations in excess of California DOHS action levels had previously been detected in the groundwater underlying the site (Levine-Fricke, 1989). These chemicals include 1,2-DBA, 1,2-DCA, trichloroethylene, CT, chloroform (TCM), Freon® 11, Freon® 113, and lead.

The U. S. Geological Survey's MODFLOW (1984) program Levine-Fricke used indicated that a simulated extraction alternative with a total discharge of 255 gpm would capture more groundwater with higher detected concentrations of contaminants near the northern part of the site than other alternatives considered with lower discharge rates. This alternative consisted of 24 well points and 13 extraction wells, forming the basis of the GWTF constructed in 1990. It would also result in a greater degree of separation of specific chemicals in the extraction discharge, thereby allowing more control over treatment processes. In addition, the greater combined extraction rate of this alternative would result in a broader area of capture of contaminated groundwater.

Groundwater Monitoring (1994 to present)

- From 1994 to 1997, groundwater sampled quarterly at 45 wells; thereafter 48 wells samples semi-annually
- *Interim MRP Report (April 13, 1997)*
  - In 1996 and 1997, conducted two sampling events, one in the wet season and one in the dry season at all site wells. This was done to establish baseline conditions for designing a new Monitoring and Reporting Program (MRP) Sampling and Analysis Plan
- *New MRP (November 18, 1997)*
  - Focused on monitoring effectiveness of GWTF
  - Sample 48 wells semi-annually
  - One annual and one semi-annual report
- The normal semi-annual event for 3Q 2001 was replaced with a sitewide sampling of all site wells. Site constituents of concern were analyzed along with natural attenuation parameters
- NPDES permit rescinded June 2001; MRP sampling associated with NPDES permit was discontinued

Phase 1 and 2 Plume Delineation Investigation (October 10, 1995; August 25, 1996)

- Groundwater sampling with CPT/Hydropunch™:
  - CPT-01 through CPT-10
  - B-101 through B-119
  - Sampled at three depths: 20 feet below ground surface (bgs), 50 feet bgs, and 100 feet bgs
  - Samples analyzed for lead, VOCs, arsenic, and fluoride
  - Investigation results indicated additional areas of groundwater contamination
- Indicated the need to re-evaluate the groundwater flow model and geologic conceptual model for this site
- Proposed effectiveness evaluation of the GWTF

Groundwater Treatment System Evaluation Field Activities Report (March 14, 1997)

- Written to document investigation activities undertaken as part of the new groundwater model development
- Documented tidal filtering study that was used as the calibration data set for the groundwater model

- Documented aquifer testing procedures and results
- Documented geologic and well installation data

Groundwater Modeling Report (March 14, 1997)

- Installed 13 piezometers (PZ-01 – PZ-13) and 11 monitoring wells (MW-59 through MW-69)
- Conducted 72-hour tidal filtering study to obtain dry-season dataset for model calibration
- Performed four 72-hour aquifer tests, two in the Upper Aquifer (GW-04 and GW-15)and two in the Lower Aquifer (GW-09 and GW-16)
- Performed numerous pneumatic slug tests at other site wells
- Re-evaluated site geologic conceptualization and developed the three layer model now used
- Evaluated existing model and determined that a new model should be developed based on new site conceptualization and hydrogeologic data
- Conclusions/Recommendations
    - New model indicated that approximately 350 gpm would be needed to get capture of site groundwater under the dry-season condition evaluated
    - Recommended that a Model Verification project be undertaken to verify validity of new model before it was used for remedial decision-making
    - Verification should consist of running model with different calibration dataset, such as one from the wet season
    - Running a series of long-term (one month) pumping tests and comparing results to model predictions

Eastern Area Investigation (April 30, 1999)

- Consisted of nine CPT/Hydropunch™ groundwater samples in the eastern area of the site
- Focused on delineating source and extent of PCE plume in eastern area of site
- Recommended additional sampling in marshy area south of Little Break and east of the TiO_2 Manufacturing Area, and one location along the levee that runs north to south from Big Break Marina. The Supplemental Eastern Area Investigation addressed these issues

Supplemental Eastern Area Investigation (February 25, 2000)

- Focused on delineating source and extent of PCE plume (Plume 3) in eastern area of site, primarily in the Surficial and Upper Aquifers. Previous sampling had indicated that Plume 3 was primarily an Upper Aquifer issue
- Seven additional locations were sampled during the Supplemental Eastern Area Investigation
    - Collected samples in Surficial and Upper Aquifers to further delineate Plume 3

- Delineated the easternmost extent of plume and confirmed the presence of PCE degradation products

❑ Conclusions/Recommendations
- Plume 3 is fully delineated
- Recommended installing MW-70 and MW-71 along levee at the edge of the San Joaquin River
- Natural attenuation is occurring
- No source area is readily identifiable. Plume 3 primarily consists of a PCE plume that has a broad area of contamination around 5 milligrams per liter (mg/L)

Source Area Investigation (April 27, 2000)

❑ Purpose was to evaluate potential Plume 1 and Plume 2 sources in the saturated zone, further evaluate plume extents, and evaluate potential for off-site migration

❑ Advanced 66 CPT/Hydropunch™ borings and collected 192 groundwater samples

❑ Focused on areas within and downgradient of manufacturing areas

❑ Collected Surficial, Upper, and Lower Aquifer groundwater samples

❑ Conclusions/Recommendations
- Plume 1 is fully characterized with routine monitoring to continue
- Recommended Plumes 2 and 3 characterization to delineate and determine if off-site migration is potentially occurring
- Plume 1 sources are within the Freon® and TEL Manufacturing Areas and associated SWMUs
- Groundwater concentrations suggest the presence of dense non-aqueous phase liquids (DNAPLs), but only one CPT/Hydropunch™ sample (TEL-10) had DNAPL (TEL)
- Sample surface water in the San Joaquin River for site-specific constituents
- Evaluate, design, construct, and operate a remedial option, possibly a PRB to control off-site migration of Plume 1 constituents
- Evaluate natural attenuation

Feasibility Study Work Plan (January 17, 2001)

The Feasibility Study Work Plan anticipated the Feasibility Study, which would present a site-wide plan for groundwater stabilization, including Plumes 1, 2, and 3. It would also incorporate the learnings from the PRB demonstration project and performance monitoring.

Consistent with the goal of protecting human health and the environment, the primary objective for addressing the Oakley site groundwater is to mitigate off-site plume migration; therefore, the purpose of this work plan and subsequent investigation activities was to collect and analyze the necessary data to screen potential remedies and work toward a program for site-wide groundwater stabilization.

Both the results from these investigations and historic site data would then be used to evaluate a variety of potential remedial technologies to identify the most appropriate remedy (or remedies) for Plumes 1, 2, and 3. In Plume 1, and in accordance with the approved work plan (CRG, 2000c), the initial 110-foot PRB pilot wall would be subjected to a rigorous testing and evaluation prior to a recommendation for installation of the 500-foot full-scale PRB. The investigation plan included coring the PRB and taking groundwater samples downgradient of the plume.

Historical data trends indicate that both Plumes 2 and 3 are at a steady state, and that natural attenuation is occurring. The laboratory studies, natural attenuation analyses, and field investigations presented in this plan were designed to provide the necessary data for assessing the effectiveness of in-situ remedies. Both the results from these investigations and historic site data would then be used to evaluate potential remedies, identify the most appropriate remedy (or remedies) for Plumes 2 and 3 (and the Plume 1 Upper and Surficial Aquifers), and develop an action plan for site-wide groundwater stabilization.

Model Verification Report (1998 and 1999, Report Submitted on April 13, 2001)

- Installed an additional 20 piezometers (PZ-14 through PZ-28 and PZ-30 through PZ-35)
- Conducted 72-hour tidal filtering study to obtain wet-season dataset for model calibration
- Conducted six long-term pumping tests, three in the Upper Aquifer and three in the Lower Aquifer
- Each test lasted approximately one month and showed that equilibrium conditions were attained
- Results of verification efforts indicated that the GWTF would need to extract 800 to 1,000 gpm in order to get capture during the wet season

Analysis and Recommendation to Suspend Operation of the Oakley Groundwater Treatment Facility (April 13, 2001)

In response to the identification of groundwater contamination at the Oakley site, DuPont voluntarily installed a GWTF as an interim groundwater stabilization measure in 1990. The GWTF was designed using data collected on the site from the mid- to late 1980s and modeling techniques available at that time. By the mid-1990s, however, the environmental industry as a whole had come to recognize that there were significant limitations to the effectiveness of groundwater extraction and treatment systems, particularly with respect to their inability to address residual levels of contamination, especially when associated with DNAPL sources.

Based on a concern with plume migration at the site identified in 1995, DuPont conducted a study, the results of which indicated that the GWTF, as originally designed and constructed, was not sufficient to provide on-site containment of groundwater migrating beneath the Oakley site (DERS, 1997). This realization, coupled with the identification of DNAPL constituents at the site, caused DuPont to initiate an aggressive technology evaluation program to identify a more effective means of groundwater remediation.

Having considered a wide range of potential alternative technologies, DuPont installed a pilot PRB in the most heavily contaminated plume (PRB Workplan, 2000). Early indications are that this technology will effectively treat contamination in site groundwater in a much more cost-effective and energy-efficient manner than the interim pump-and-treat system. It was estimated that to upgrade the existing pump-and-treat system to contain site groundwater, notwithstanding additional treatment trains anticipated to address naturally occuring levels of arsenic and total dissolved solids (TDS), would cost approximately $65 million (30-year net-present value). This compares unfavorably with the more effective in-situ destruction technology offered by, for example, a comprehensive site-wide PRB installation at a cost of roughly $10 to $15 million.

Both technological limitations and economic inefficiency indicated that continued operation and/or expansion of the Oakley groundwater pump-and-treat system was not warranted. DuPont therefore recommended that the Water Board concur with respect to the decision to discontinue operation of the pump-and-treat system at Oakley, in favor of other, more effective and efficient means of groundwater quality improvement. The CVRWQCB concurred in a letter dated May 4, 2001.

Phase I PRB Construction Completion Report (July 11, 2001)

The Pilot scale PRB, also referred to as Phase I, is 110 feet in length installed from a depth of 45 to 50 feet bgs to a total depth of 110 to 115 feet bgs and has an average iron-effective thickness of six inches. The PRB installation program is directed at mitigating potential off-site migration of contaminants from Plume 1 in the Lower Aquifer. Plumes 2 and 3 were still being investigated at the time of this construction and will be addressed in future groundwater stabilization efforts. The purpose of the PRB is to significantly reduce the levels of VOCs present in the plume including CT, CFC-113, CFC-11, and 1,2-DCA.

Site preparation activities were initiated on October 9, 2000 and completion of the Phase I PRB installation, including QA/QC verification testing, site restoration and demobilization, was completed by February 26, 2001. Post-PRB QA/QC verification testing was completed to evaluate PRB effects on the groundwater flow regime due to the installation method and to quantify the PRB average thickness. Post-PRB hydraulic pulse testing indicated that the installed PRB did not alter the formation hydraulic characteristics. Although complete and undisturbed core samples of the PRB could not be recovered, partial samples indicated that the PRB was in the desired six-inch thickness range.

Plumes 2 and 3 Characterization (August 1, 2001)

- Tasks completed:
    - Sampled groundwater beneath Little Break at 12 locations using CPT/Hydropunch™ technology from a barge
    - Installed MW-70 and MW-71 along site's northern levee to monitor Plume 1 and Plume 2 in the Upper and Lower Aquifers
    - Sampled additional wells in areas adjacent to Little Break
- Purpose of the investigation was to:
    - Determine extent of Plumes 2 and 3 in the area beneath Little Break

- Determine if Plumes 2 and 3 extend off-site
- Evaluate fate of lead, EDC, EDB, and PCE/daughter products

- Conclusions/Recommendations
  - Determined that Plumes 2 and 3 do not migrate off-site and that natural attenuation is occurring

2.5.3 Surface Water Investigations

San Joaquin River and Little Break Surface Water Sampling (August 4, 2000)

- Surface water sampling was performed at 12 locations in the San Joaquin River in the spring of 2000 (wet season)
- Toluene and benzene detected at one location, but determined not to be from site
- Lead was detected at one location near the main channel of the San Joaquin River, but site lead plumes do not reach the river's edge and all other lead samples were non-detect
- A second round of sampling was performed in October 2001 (dry season); results were non-detect for all constituents

2.5.4 Sediment Characterization

No sediment data have been collected for the Oakley site; however, because of the proximity of Plume 1 to the Lauritzen Yacht Harbor, DuPont offered to sample marina sediments for dredge waste disposal characterization. Samples were analyzed for all Plume 1 constituents, as well as constituents related to boating operation and maintenance; no Plume 1 constituents were detected. Lauritzen Yacht Harbor subsequently completed dredging operations in November 2001.

2.5.5 Soil Gas Characterization

No formal reports have been submitted for vadose zone characterization, but the following activities have been pursued:

- Flux box sampling above Plumes 1 and 3
- Lauritzen Yacht Harbor multi-media sampling
- GORE-SORBER® passive soil gas survey in Plume 1 Source Areas

These data will be summarized and discussed in Section 5.3.

2.5.6 On-going and Future (Near-term) Site Activities

On-going work at the site consists of monthly PRB monitoring activities in wells upgradient and downgradient of the PRB. Results are evaluated to better understand the PRB performance.

A *Marsh Well Installation Workplan* was submitted to the DTSC on September 10, 2002 detailing well installation activities that will commence in early November 2002. The proposed well locations are shown in Figures 3-35 through 3-37. Well locations MW-90 through MW-93 and MW-103, 104, 105, and 107 will be installed in November with the remainder to be installed in 2003.

As part of the effort to clarify the CSM, DuPont has performed two rounds of a soil gas survey in 2002 in the Plume 1 CFC Manufacturing Area. This effort used passive soil gas samples to monitor the relative concentrations of VOCs in potential source areas. Based on the results from this sampling effort, DuPont is planning additional investigations using the membrane interface probe (MIPs) technology to better characterize the vertical distribution of VOCs in the Plume 1 source areas and along the flow axis of the plume. The MIPs investigation is slated to occur in the fourth quarter 2002.

In addition to the field activities mentioned above, DuPont is collecting soil samples for lab sorption/desorption studies, laboratory microcosm studies, and other studies to evaluate the effectiveness of various treatment technologies in Plumes 1, 2, and 3.

During the transition from CVRWQCB to DTSC as lead agency, DuPont pursued delineation activities along the western and northern boundaries of Plume 1 on the Lauritzen Yacht Harbor property. DuPont initially collected CPT lithologic logs and discrete groundwater samples from the Surficial, Upper, and Lower Aquifers (LM-01 through LM-04) and analyzed them for VOCs. Based on these results, DuPont installed a series of 13 new wells along the western boundary of Lauritzen Yacht Harbor. The newly installed wells are MW-78 through MW-89 and MW-106. Analytical results from several of these wells indicate that the northwestern boundary of Plume 1 has not yet been fully delineated. In the fourth quarter of 2003 work is planned to further investigate the northwest portion of Plume 1 within the Surficial and Upper Aquifers by collecting CPT lithology and discrete groundwater samples along a transect perpendicular to groundwater flow (locations to be denoted as "RD").

3.0 ENVIRONMENTAL SETTING

3.1 Site Setting

3.1.1 Topography

The DuPont Oakley site is located on the south bank of the San Joaquin River, east of the Highway 160 bridge, seven miles upstream of the confluence with the Sacramento River. This area is known as the San Joaquin – Sacramento Delta Valley. Topography in the vicinity of the plant can be characterized as gently rolling to flat. Ground surface slopes from hills a few miles southwest of the site northward toward the river.

Figure 2-3 displays the topography of the site itself. Elevation at the site ranges from approximately 25 feet above mean sea level in the southern portion of the property (near the Burlington Northern/Santa Fe Railroad track) to a few feet below mean sea level in the sloughs along the river. Although the general slope is toward the river and Little Break Marsh, several areas of fill and significant flat areas where the plant buildings once stood have modified the natural topography. The most significant break in topography occurs near Little Break Marsh, where the sandy slope of the plant upland area terminates and the flat marsh of Little Break begins. This boundary is most clearly visible in areal photographs during dry periods when grassy areas turn brown, but the marsh vegetation remains green.

3.1.2 Surface Drainage

The surface soils in the upland areas of the site and in the upgradient areas are fine silty dune sands with little vegetation. There are few to no observable natural surface drainage features, indicating that much of the rainfall infiltrates rather than running off as overland flow. It appears that actual recharge is very high in this area due to the surficial dune sands. In fact, rainfall and runoff are observed as part of the site's General Industrial Permit and no overland flow has been noted. A one-way valve allows tidal inflow, but was designed to restrict outflow from the Central Slough to Little Break (see Section 3.4.2 for further details). The site storm water drainage system leading from the West Basin to the NPDES-permitted outfall (now rescinded June 14, 2001 by Order #5-01-137) has been plugged at all inlet and outlet points. The infall and outfall at the West Basin were closed and locked around April 4, 2000, while the catch basin for the conveyance to the West Basin was plugged on October 4, 2000.

3.1.3 Regional Climate

During the year, the central California area has a definite wet season from October through April, during which time much of its annual precipitation occurs. The dry season makes up the balance of the year. Due to the substantial seasonal variation in rainfall, there is also substantial variation in recharge and growth of vegetation.

3.1.4 Land Uses

Figure 2-1 displays the historical and current property boundaries of the site and adjacent properties. The DuPont site itself has been used for a mix of industrial and agricultural use since the 1950s. Aside from a farmhouse east of the plant and a house on the Big Break Marina property, there were no residences actually on DuPont property. Surrounding the DuPont site are marinas, a highway, electrical substations, a metal scrapyard, vineyards and marshland.

3.1.5 Ecology

The site's original ecological zones have been disrupted by industrial and agricultural uses. The upland area of the site appears to have been largely open grassland prior to settlement. When the plant was constructed in the 1950s, the upland area was a mix of grape vineyard and almond orchard with lines of eucalyptus trees forming windbreaks. Most of the almond trees have since been replaced with vineyard, and some of the original vineyard is now fallow.

The ecology of Little Break, in contrast, has largely remained uninfluenced by activities conducted by DuPont, with the exception of roads that have been built to provide access to site monitoring and recovery wells. When the area was first settled, the Little Break area was "reclaimed" from the San Joaquin River by the construction of levees. This was a common practice and a substantial part of the San Joaquin-Sacramento River Delta was reclaimed in this fashion. After the main levee was breached (pre-DuPont ownership), the reclaimed area was flooded and freshwater tidal wetlands conditions returned. The area referred to as Big Break to the east of the site was also once reclaimed land, but the levee protecting the area also broke and the area is again shallow wetlands.

3.2 Regional Geology and Hydrogeology

3.2.1 Regional Geologic Maps

Numerous references are made on regional geologic maps and in the following sections to geologic time scale. As a reference, Appendix 3-1 contains the most recent portion of the geologic time scale as well as discussions published with the two regional geologic maps presented as Figures 3-1 and 3-2.

Regional Geologic Map – Alluvium

Figure 3-1 displays a portion of a geologic map that differentiates the unconsolidated Quaternary-aged alluvium unit near the site. Nearly all the developed portion of the site was built on an inactive dune sand deposit (shown on the map as Qds). Near the San Joaquin River is a unit described as peaty muck (Qhpm). This unit is composed of very recently deposited (Holocene) low-lying marsh deposits (primarily peat with sand, silt or clay). Sherman Island (north of the site) like most of the islands in the San Joaquin Delta is entirely covered by the Qhpm unit.

The area where these two units meet corresponds directly to the transition from gently sloping sandy soil to the Little Break marsh. The map also shows that the area around

Lauritzen Yacht Harbor and Driftwood Marina, as well as near the former Emergency Basin and Ponds, has been built up with artificial fill.

To the south and west of the Oakley site, a Holocene-aged alluvial fan unit (Qhaf) is adjacent to the bedrock hills. Further west another alluvial fan interpreted to be of Pleistocene age (Qpaf) is exposed. Because it is older, it is likely that there are Pleistocene aged fan deposits beneath some of the Holocene fan deposits. These alluvial fans are believed to extend beneath the dune sand deposits, interfingering with sediments from the San Joaquin River, and form the majority of the unconsolidated sediments beneath the site.

Regional Geologic Map – Bedrock

Figure 3-2 is similar in scale to Figure 3-1, but this map differentiates only between bedrock units. Tertiary-aged layers of sedimentary bedrock form the hills to the southwest of the Oakley site. Also shown on Figure 3-2 is the Antioch Fault, which is a right lateral strike-slip fault to the southwest of the site. Further southwest towards Mount Diablo, progressively older bedrock units are exposed. According to information from files related to the site's former deep injection well (DuPont WDW No. 1), many of these units are present beneath the site. Data related to DuPont WDW No. 1 are discussed further in Section 3.2.2.

Figure 3-2 shows only some of the Tertiary units. Bedrock units shown on Figure 3-2 have been lifted and tilted such that the dip of these units is to the north-northeast at between 10 and 23 degrees. The oldest bedrock units (Jurassic) exposed in the area are present to the northeast of Mount Diablo. Bedrock exposed at the surface is progressively younger as one approaches the Oakley site. The youngest surficially exposed bedrock is the Pliocene-aged Tulare Formation. This unit is approximately one and a half miles from the site. Further southwest, but not shown on the map, are older bedrock formations such as the Domingine Sandstone, which reportedly extends beneath the site.

Absent from Figure 3-2 is the poorly consolidated Montezuma Formation, a Pleistocene-aged marine silt with minor clay and sand. The Montezuma was reportedly deposited during a previous interglacial period (it has not been confirmed which one). At that time, the area near the site would have been a bay and the edge of the San Joaquin and Sacramento River deltas would have been east of their present locations. The Montezuma Formation, therefore, was deposited as an extensive bay bottom deposit. In Solano County, the Montezuma Formation is exposed in the Montezuma Hills, an area of local uplift north of the site. At the site, however, approximately 120 feet of unconsolidated sediment (the Qhaf, Qds, and Qhpm mentioned above) cover the Montezuma.

3.2.2 Deep Injection and Oil and Gas Well Logs

Appendix 3-2 contains information from files associated with the deep waste injection well installed at DuPont in 1955 and abandoned on April 8, 1982. This well is referred to as DuPont WDW No. 1. These files include:

- A handwritten general geologic history of the Sacramento Valley

- A summary of the lithology from the drilling of the DuPont waste injection well (DuPont WDW No. 1) drilled to a depth of 6,800 feet
- The first 1,800 feet of electrical log from DuPont WDW No. 1
- Construction details of the well
- The 1956 report detailing the "Geologic Conditions & Land Status Existing in the Vicinity of the E.I. du Pont de Nemours & Co. Properties Near Antioch-Oakley, California"

Although the deepwell files were mostly focused on the deeper Tertiary sandstone units, such as the Domingene and Meganos Sandstones, important information was also found relating to shallower units. The spontaneous potential (SP) electric log for DuPont WDW No. 1 clearly shows a predominantly sandy upper 110 to 120 foot interval, followed by a relatively high and stable SP reading from a depth of 120 feet to 390 feet bgs. The 120 to 390 foot interval is interpreted as being the Montezuma Formation. The lithology summary (also included in Appendix 3-2) confirms the findings of the electrical logging, describing the upper 42 feet as "silty sand", the 42-120 foot interval as "gray sand" and the 120-400 foot interval as "gray to brown shale with streaks of sand". Below the Montezuma, the lithologic summary reports 40 feet of shaley sand, followed by more shale. Both the lithologic and SP logs indicate primarily shale below that 400-440 foot sand with the next sandstone indicated by the SP log from 660-695 feet. Based on the reports completed at the time of the installation of DuPont WDW No. 1, several of the deeper formations encountered by DuPont WDW No. 1 are present in the hills flanking Mount Diablo to the southwest of the site. The construction log for DuPont WDW No. 1 shows the intervals that the Domingene, Upper Meganos and Lower Meganos Sands were encountered. These units outcrop approximately six to seven miles southwest of the site.

3.2.3 Antioch Bridge and Sherman Island Cross Sections

Figure 3-3 displays the location of two cross sections. These cross sections are displayed on Figure 3-4. The first cross-section (A-A') trends south to north across the San Joaquin River at the Antioch Bridge following Highway 160. The second cross section (B-B') follows the south levee that prevents flooding of Sherman Island.

Cross section A-A' displays a south to north view of the first 240 feet of the subsurface. The upper 110 to 120 feet is composed of unconsolidated sediment. Beneath the unconsolidated sediment is the semi-consolidated Montezuma Formation. Peat is present across the surface of most of the cross section, but is thickest on Sherman Island, while it is notably thinner on the south side of the San Joaquin River. Gravely sand composes most of the lower portion of the unconsolidated sediment, but is limited to between 60 and 120 feet, and is less widespread beneath Sherman Island. Clay and silty clay are more prevalent in the upper portion of the unconsolidated zone, and are significantly thicker beneath Sherman Island, composing most of the upper 60 feet of sediment.

Cross section B-B' is a west to east view of boring logs completed along the edge of the levee which protects Sherman Island. This levee is shown near boring B12 on cross section A-A'. Because the surface elevation of Sherman Island is approximately 10 feet below mean sea level (MSL), the first 20 feet of material on cross section B-B' is probably fill. These borings all terminated in sand rather than the Montezuma Formation, and with the exception of a few limited areas (borings 91, 92, and 93), most sand in the cross section is confined to below -60 feet MSL. The majority of the sediment in cross section B-B' above the deeper sand is a mix of peat, silt, and silty sand.

3.2.4 Generalized Regional Geologic Cross Section

Based on the data discussed in Sections 3.2.1 through 3.2.3, a generalized regional cross section has been constructed from the hills southwest of the site to Sherman Island. This cross section is presented as Figure 3-5. The location of this cross section was shown on Figure 3-2.

Sherman Island

As can be seen on the cross section, the Oakley site is directly adjacent to the San Joaquin River. Northeast of the river is Sherman Island, the surface of which is estimated to be on average ten feet below sea level. Sherman Island is virtually flat with the exception of its levees, and most of the sediment underlying the island is Holocene-aged peaty muck (Qhpm). The peaty muck is consistent with the depositional environment of Sherman Island being at the distal edge of the San Joaquin fluvial delta. The gravelly sands shown below the Qhpm on Figure 3-4 are assumed to be alluvial fan deposits shown on Figure 3-1 and discussed in Section 3.2.1 (either Qhaf or Qpaf). The gravely sands that extend beneath Sherman Island are, therefore, hydraulically connected to the Lower Aquifer, discussed in detail in Section 3.3.

South Side of San Joaquin River

In very general terms, the lowest 60 feet of the first 120 feet of sediment is massively bedded gravely sand and sand. Above that lower unit is an aquitard of silt and clay that tends to thicken toward the San Joaquin River and occupies the 50 to 60 foot depth interval. The 10-50 foot interval of sediment at the site can be generalized as being sand and silty sand. This upper sand unit is thinner bedded than the lower sand unit, and corresponds to what is referred to at the site as the Upper Aquifer. This sand unit does not appear to extend beneath Sherman Island, but is directly beneath the San Joaquin River. The surficial sediments at the site are either fine, very well sorted sand (dune sand), or silty/sandy peat (peaty muck). The site, therefore, is located in a transitional zone where alluvial gravel and sand is interbedded with fluvial silt, clay and peat. Site borings are described in further detail in Section 3.3.

Beneath the San Joaquin River valley is the Montezuma Formation. At the site, the Montezuma was found to extend from 120 feet to a depth of 390 feet based on the SP electrical log. Based on discussions with URS geologists in Oakland, California, the Montezuma extends deeper (to about 800 feet) near Pittsburgh at the Dow Chemical site. Because of this variability in the Montezuma, the contacts shown on Figure 3-5 are very tentative.

Information from the summary of lithology and the electrical log of DuPont WDW No. 1 is also shown on Figure 3-5. This information indicates that, with the exceptions of sandstone at 410-440 feet and 660-690 feet, most of the remaining 1,000 feet of sediment beneath the Montezuma is shale.

Southwest of the site, the ground surface slopes up to sedimentary bedrock hills. The first of these formations is the Pliocene-aged Tulare Formation, described as a poorly consolidated, non-marine, gray to maroon siltstone, sandstone and conglomerate. Further southwest are progressively older sedimentary units, which have been locally uplifted and tilted by the lifting of Mount Diablo. Based on strike and dip readings shown on Figure 3-2, these bedrock units dip northward between 10 and 23 degrees. Because the cross section has been vertically exaggerated, the slope is shown much steeper than the actual slope. Sedimentary units not shown on the map or cross sections include the Domingene, Upper Meganos and Lower Meganos Sands (Eocene to Paleocene aged). These units outcrop to the southwest of the site and were also encountered by DuPont WDW No. 1, demonstrating that the units extend beneath the site.

3.3 Site Geology and Hydrogeology

3.3.1 Site Geology

Approximately 120 feet of unconsolidated fluvial sediment is present beneath the site above the Montezuma Formation. This sediment is primarily sand and gravel with minor layers of silt and clay. These silt and clay layers are not extensive over a very wide area, therefore, on a regional scale, this unconsolidated unit could be considered the "uppermost aquifer". On the scale of the site, however, the silt and clay layers act as locally confining layers. This section details what is currently known about the upper 120 feet. This information comes from well logs and cone penetrometer testing (CPT) logs conducted at the site. These logs are included as Appendices 3-3 through 3-5. Using 54 of these logs (primarily CPTs), a lithologic visualization model of the site has been constructed using the EVS software package. Appendix 3-6 contains a summary of the model's data set and a series of maps and cross sections. Other boring logs are referenced in the following section, many of which have not been used in constructing the EVS model. Please refer to Appendices 3-3 through 3-5 for the logs.

Depositional System

Figure 3-6 displays the locations of six stratigraphic cross sections which were constructed by the EVS model. These cross sections are included as Figures 3-7 through 3-12. As noted in previous sections, the unconsolidated sediment beneath the site is interpreted to be a mix of alluvial fan and fluvial sediments. In Table 3-1, the site stratigraphy has been conceptualized into seven major units. These designations have been used on the cross sections.

Surficial Aquifer, Surficial Peat, and Surficial Clay

In the upland portion of the site (at PZ-36), approximately 20 feet of fine, tan sand composes the Surficial Aquifer. Figure 3-7 (Cross section A-A') displays the Surficial Aquifer thinning with proximity to the San Joaquin River and being replaced with sandy peat near the marinas. Cross section E-E' (Figure 3-11) is slightly east of cross section A-A' (see Figure 3-7) and shows the same thinning of the Surficial Aquifer and the abrupt appearance of peat north of the Central Slough. The first 20 feet of PZ-10, installed between the Central Slough and the former Emergency Basin, is silty sand with abundant peat layers. At the furthest point north near cross section E-E', MW-46 has 32 feet of peat. Cross section B-B' (Figure 3-8), slightly further east of E-E', shows the peat unit further south because the edge of the marsh is further south in this cross section. Cross section D-D' (Figure 3-10) shows the Surficial Aquifer present to a point just east of the former TiO_2 unit. At CPT location 99EA-11, Little Break Marsh begins and the Surficial Aquifer grades into sandy silt. At a few locations near Little Break, the Surficial Aquifer is not replaced with peat, but rather silty clay (such as at PZ-13). This situation also occurs near the marinas (MW-64, MW-65, MW-81 and MW-85) and near the Central Slough (LF-13). Cross section F-F' (Figure 3-12) displays very little Surficial Aquifer because the uppermost unit is mostly sandy or silty peat directly adjacent to the river. Further out in Little Break, however, there is a soft surficial silty sand present at LB-04 and -05. The Surficial Aquifer appears to be in contact with the Upper Aquifer at those two locations.

Figures 3-13 and 3-14 display the extents of the Surficial Aquifer and Surficial Peat units. Although there is some overlap of the two units, the Surficial Aquifer is thickest to the south and is absent from several locations near the river. Conversely, the Surficial Peat becomes thickest where the Surficial Aquifer is absent. Because these maps are interpolations of data by EVS, some of the interpretations may be questioned in this area with sparse data and may need to be revisited as more data becomes available. CPT locations SCM-20 and 99EA-16 for instance are suspect, because no peat was shown at these locations. SCM-20 is near MW-46, which is known to have peat to a depth of 32 feet bgs. In addition, some features on Figure 3-13, such as showing peat to the southeast of the former TiO_2 area and much too far south from the Lauritzen Yacht Harbor and Driftwood Marina, are due to the kriging interpolation of the model. These effects will be limited by adding additional control points for the lithology as the model is refined. The EVS Model is evergreen and will be updated as new data become available.

Surficial/Upper Aquitard

Underlying most of the Surficial Aquifer is the Surficial/Upper Aquitard (S/U Aquitard). It is described in boring logs as a tan, brown, or dark greenish-gray clayey silt or silty clay. The S/U Aquitard is thickest beneath the former CFC Manufacturing Area and on the west side of the former AKC Manufacturing Area. It thins to the north and east, where the Upper Aquifer is closer to the surface (see Figure 3-15). The hydraulic conductivity of the S/U Aquitard varies as shown in the geotechnical lab results depicted in Table 3-2.

At PZ-36 (next to Highway 4), the S/U Aquitard is described as an interbedded unit of clay, silt, and silty sand. The net silt and silty clay thickness is 11 feet at PZ-36. Further north, in the former CFC Manufacturing Area, the S/U Aquitard is thicker (15 to 20 feet thick), composed of more silty clay, and is not interbedded (see monitoring wells LF-08 through LF-14 and CPTs FMA-12 and FMA-13). In the former AKC Manufacturing Area, the S/U Aquitard is at approximately the same depth and thickness (15 feet) as in the CFC Manufacturing Area.

North of the former CFC Manufacturing Area, the S/U Aquitard is thinner at GW-17 and GW-18 (3 feet of silt). Numerous other nearby borings, however, such as GW-16 (9.5 feet of silt and 10 feet of clay), PZ-06 (26 feet of silty clay), GW-11 (19 feet of sandy clay), and several CPTs, indicate that the S/U Aquitard is nearly the same thickness in this area.

Based on Figure 3-15, the S/U Aquitard thins and is absent in the eastern part of the site (part of the Plume 3 area). Boring logs from GW-01 (3.5 feet of silty clay), GW-03 (2 feet of silt), LF-32 (6 feet of clayey silt and silty clay) confirms that the S/U Aquitard does thin significantly. The S/U Aquitard is also thin at PZ-09, PZ-10, and PZ-11 (2 feet of clay).

Upper Aquifer

The top of the Upper Aquifer is typically at a depth of approximately 20 feet bgs. This sand unit normally extends to about 40 to 45 feet below ground surface. The Upper Aquifer is present across nearly the entire site although its grain size, thickness, and actual top and bottom elevations vary. Table 3-3 displays a summary of properties determined during pump tests in the Upper Aquifer during 1996.

All six cross sections show a narrow medium brown sand between what are called the U1 and U2 Sands. This distinction has been made because some CPT logs (such as SCM-04) display two clearly distinct sand sequences separated by silt or silty clay. At most other locations (such as SCM-02 and SCM-03), there appears to be a single continuous sand layer that may or may not have been deposited in separate events. In most boring logs, there is little apparent separation of distinct U1 or U2 sands.

South of the site at MW-59, the Upper Aquifer is slightly thicker (34 feet) than in most borings beneath the site and the base of the Upper Aquifer is deeper (61 feet). The same is true at PZ-36 (about 25 feet of sand, with a bottom at 58 feet bgs). Although the Upper Aquifer is present across nearly the entire site, logs from both MW-70 and MW-71 indicate that the Upper Aquifer becomes clayey silt in the northeasternmost corner of the site. Only slightly west of MW-70 and MW-71, logs from PZ-34 and PZ-35 and especially MW-52 and MW-73 (which had running sand), indicate the Upper Aquifer is considerably thicker and coarser grained.

The Upper Aquifer is also present along the west edge of the site but is deeper than usual. The logs from MW-61 and MW-63 (west side of site) shows the Upper Aquifer from 32 feet to 60 feet bgs and from 22.5 feet to 54 feet bgs, respectively. Only about 300 feet east at PZ-02, the Upper Aquifer only extends from 24 feet to 43.5 feet bgs.

The Upper Aquifer is also encountered at a greater depth in the former CFC Manufacturing Area and the west side of the AKC Manufacturing Area. Both CPTs and "LF-" wells indicate that the top of the Upper Aquifer begins at 30 to 35 feet bgs in these areas (see CPT FMA-12, FMA-13, and many TEL area CPTs such as TEL-01, TEL-02, TEL-07, TEL-08, TEL-09, TEL-10, TEL-15, TEL-16, TEL-17, and TEL-19). In the east side of the AKC Manufacturing Area, however, TEL-11, TEL-12, TEL-13, and TEL-14 show an abruptly shallower top of the Upper Aquifer to the point where the Surficial Sand and Upper Aquifer are in contact (S/U Aquitard absent).

Upper/Lower Aquitard

The thickness and characteristics of the Upper/Lower Aquitard (U/L Aquitard) vary considerably across the site. Like the S/U Aquitard, this unit is believed to be fluvial in origin and deposited during an interruption of the deposition of the alluvial fan sands and gravels. The unit is thickest in the northeastern portion of the site and thinnest (even absent in some places) to the west and southwest (see Figure 3-16). Because the aquitard is not consistently clay or silt, the hydraulic conductivity varies greatly. The hydraulic conductivity results from samples of the U/L Aquitard are shown in Table 3-4.

The U/L Aquitard extends across nearly the entire site, however, it is thinnest in the southwest and west edge of the site where the Upper Aquifer extends deeper than elsewhere at the site. At MW-63 for instance, the U/L Aquitard is only a thin silt between 54 feet and 55 feet bgs. At CPT SCM-01, the Upper Aquifer is so thick that it appears to have been deposited on top of the Lower Aquifer. It is also believed that the unit is thin at MW-61. At these western locations, the bottom of the Upper Aquifer is nearly in contact with the Lower Aquifer (because the Upper Aquifer extends deeper). As mentioned above, PZ-02 is slightly east of MW-63, yet the U/L Aquitard is encountered approximately 10 feet higher (at 43.5 feet). The unit remains relatively thin (4.5 feet), however, and is described as "fine silty sand with 1-3 inch silt and clay lenses". This pattern is repeated at PZ-04 where the top of the U/L Aquitard is 39 feet bgs, and the unit remains an interbedded silty sand and silty clay only five feet thick. Slightly further east, at PZ-06, the U/L Aquitard is only three feet thick and is at the same approximate depth as at PZ-04, but the clay content of the unit has increased. This same U/L Aquitard pattern (approximately five feet thick and interbedded with silty sand) is present at PZ-09, PZ-31, and MW-67.

As one moves east, there is, however, a transition beginning at PZ-23, MW-39, PZ-10, GW-06, PZ-24, and PZ-27 where the U/L Aquitard thickens to at least 10 feet of clay or more. The top of the unit remains at about the same depth, but another deeper clay layer appears, sometimes with a layer of silty sand between the two clays. North of this boundary, beneath Little Break and toward the river, the U/L Aquitard is thicker. At the northeasternmost well (MW-70), not only is the Upper Aquifer replaced with blue-gray silt and clayey silt (the surficial unit is peat and silty sand), the U/L Aquitard is encountered from 50 feet bgs and extends to approximately 85 feet bgs.

At the far south edge of the site, the U/L Aquitard is much deeper bgs, but is not significantly lower in elevation than in wells south of the transition mentioned above. MW-60 (along Highway 4) has 8 feet of silty clay starting at a depth of 61 feet bgs (approximately –39 feet MSL). At PZ-36 (east of MW-60), there is 6 feet of silty clay at a depth of 58 feet bgs (approximately -36 feet MSL). The U/L Aquitard at PZ-34 (at the San Joaquin River) is encountered only slightly higher (at -32 feet MSL). With the exception of the far western borings, the top of the U/L Aquitard is reasonably consistent. Many of the LF wells have been discounted in this discussion because they were drilled using mud-rotary and may have missed the U/L Aquitard contact. At the northwestern corner of the site the log from MW-63 shows the Lower Aquifer to be separated from the Upper Aquifer only by a thin silt at the 54 feet to 55 feet bgs depth.

Lower Aquifer

The Lower Aquifer is predominantly a mix of sand and gravel with some silt or clay layers (up to about 10 feet thick at SCM-08). The Lower Aquifer has been subdivided into five subunits: the L1, L2, and L3 Sands and two silt or clay layers. Variations in thickness of the Lower Aquifer appear to be caused by some of the subunits (usually L1) grading into finer material, or not having been deposited. In general, the L2 and L3 are the most extensive subunits of the Lower Aquifer, being present across the entire site, and apparently extending beneath the San Joaquin River and under Sherman Island (see Figure 3-4). The L2 and L3 are also the most gravelly of the site aquifer units.

The top of the Lower Aquifer is as shallow as 55 feet bgs or as deep as 85 feet bgs (at MW-70). The bottom of the Lower Aquifer corresponds to the top of the Montezuma Formation across nearly every location at the site (except PZ-36). The bottom of the Lower Aquifer ranges in depth from 106 feet to 140 feet bgs (discounting PZ-36). Table 3-5 displays a summary of properties determined during pump tests in the Lower Aquifer during 1996.

At the northwestern corner of the site the log from MW-63 shows the Lower Aquifer to be separated from the Upper Aquifer only by a thin silt at the 54 feet to 55 feet depth. SCM-22 confirms this; showing only interbedded sandy silt and silty sand. Logs from PZ-02 and MW-63 also show two (25+ feet thick) fining upward sequences of sandy gravel overlain by medium to coarse sand (the two sand subunits at MW-63 are separated by a silt at 70 feet to 72 feet.

East of these wells (PZ-04, PZ-06, and MW-67) also have two massive gravel and sand layers (L2 and L3 Sands). At PZ-04 and MW-67 (slightly north – at Lauritzen Yacht Harbor), the L1 Sand, thinner and finer grained, appears around 45 to 55 feet bgs.

At SCM-15, FMA-12, and LF-09 (in the CFC Manufacturing Area), the L1 Sand subunit has thickened and coarsened. Slightly east of the CFC Manufacturing Area at TEL-01, the L1 has thickened to the point where the Upper Aquifer is again only separated by a thin clay at about 38 feet to 40 feet bgs. CPTs under the former AKC and TiO_2 Manufacturing Areas (such as SCM-02 through SCM-06) continue to show at least two separate and distinct sand subunits in the Lower Aquifer between 60 feet and 110 feet bgs.

The Lower Aquifer just south of Little Break Marsh has two (TP-13) to three (CPT TP-07) sand subunits. PZ-24 confirms that there are two subunits deposited one on top of another. PZ-27 through PZ-30 did not note two fining upward sequences although they did note that the top of the Lower Aquifer is higher.

Near the San Joaquin River, the Lower Aquifer is present but decreases in thickness to the east as the top of the unit becomes deeper. At MW-46, the top of the Lower Aquifer is at 64 feet bgs and extends to a depth of 116 feet bgs. About 600 feet east at PZ-34 the Lower Aquifer is between 75 feet to 114 feet bgs. Another 600 feet east, at MW-70, the top of the Lower Aquifer is even deeper (at 85 feet to 115 feet bgs). No CPT data are available near the river, but it is assumed that the upper subunits of the Lower Aquifer (L1 and L2) thin and disappear further in this direction. It is known from borings shown on Figure 3-4 that the Lower Aquifer does extend below the San Joaquin River and Sherman Island at the Antioch Bridge.

Top of the Montezuma Formation

Figure 3-17 is a map depicting the top of the Montezuma Formation. This surface is not flat. Because the top of the Montezuma is approximately 100 feet below current mean sea level, it is very likely that the upper surface of the Montezuma was exposed and eroded during previous low sea level stages.

A key feature of the top of the Montezuma is that the elevation beneath the former CFC Manufacturing Area is a highpoint relative to the rest of the site. Four locations show this to be a large rounded "hill" that slopes gently to the north, but more steeply to the southwest. The suspected source areas of the CFC Manufacturing Area are on the north slope of this "hill" with any potential gravitational flow of DNAPL moving toward the north.

3.3.2 Groundwater Level Measurements

The potentiometric surfaces of the aquifer units at the Oakley site indicate that groundwater flow is generally to the north, toward the San Joaquin River. The average elevation of the river is slightly above sea level (about 2 feet MSL), but this varies due to tidal cycles and seasonal flow of the San Joaquin River. Seasonal and tidal effects have also been documented in the groundwater potentiometric surface. During the wet season, the strongly seasonal rainfall patterns noted in Section 3.1.3, increase hydraulic gradient and raise the flow of the San Joaquin over the time scale of a few months. The tidal cycle in the river induces tidal fluctuations in the aquifers over the time scale of several hours.

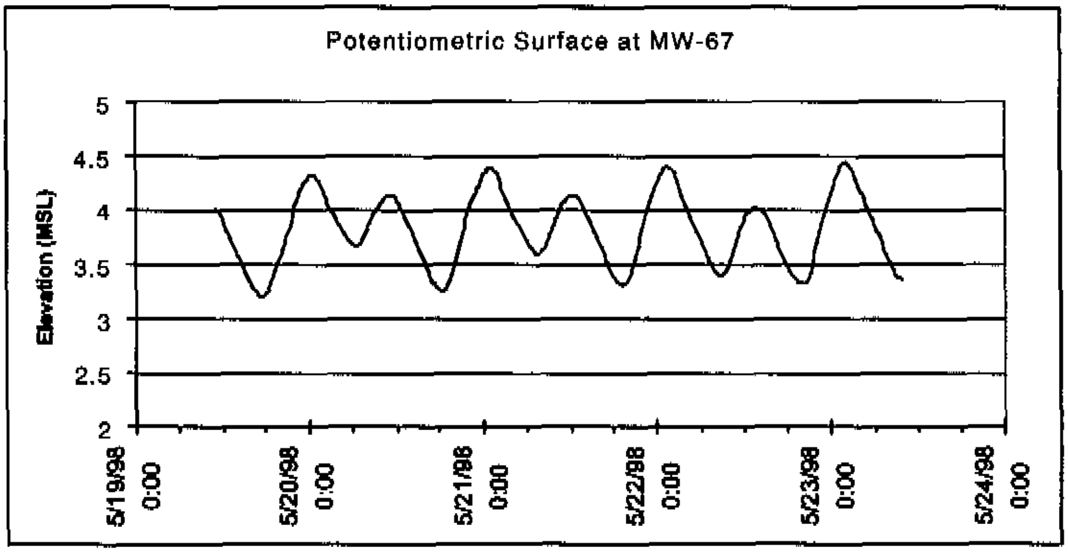
Two sets of site-wide potentiometric surface data have been used to generate the potentiometric surface maps included as Figures 3-18 through 3-23. These two sets of data (wet season data collected in May 1998, and dry season in August 1996) were collected during a short period of time and "filtered" for tidal effects (see Table 3-6). The filtering process included measuring water levels in the river during the measurements of monitoring wells and subtracting out the effects caused by the tides on the data.

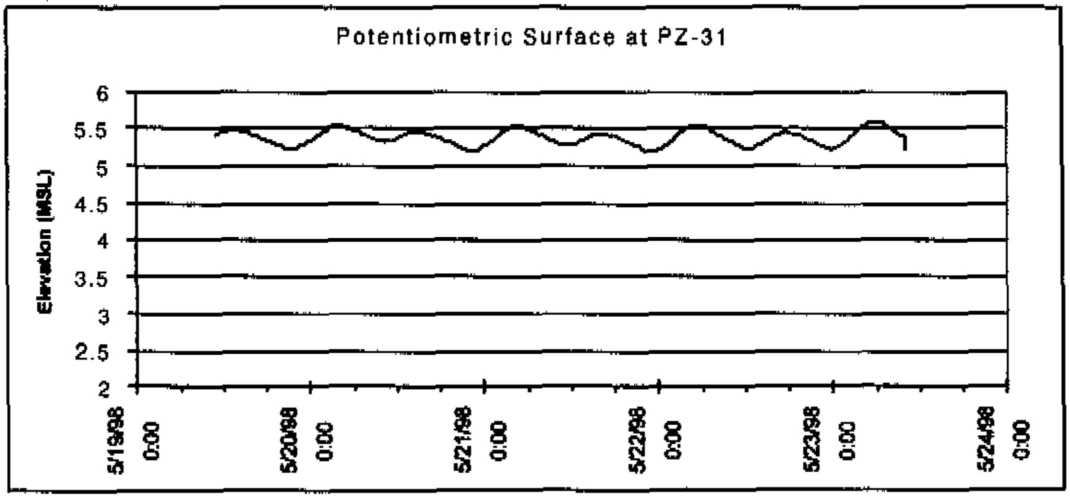
3.3.3 Surface Water Level Monitoring

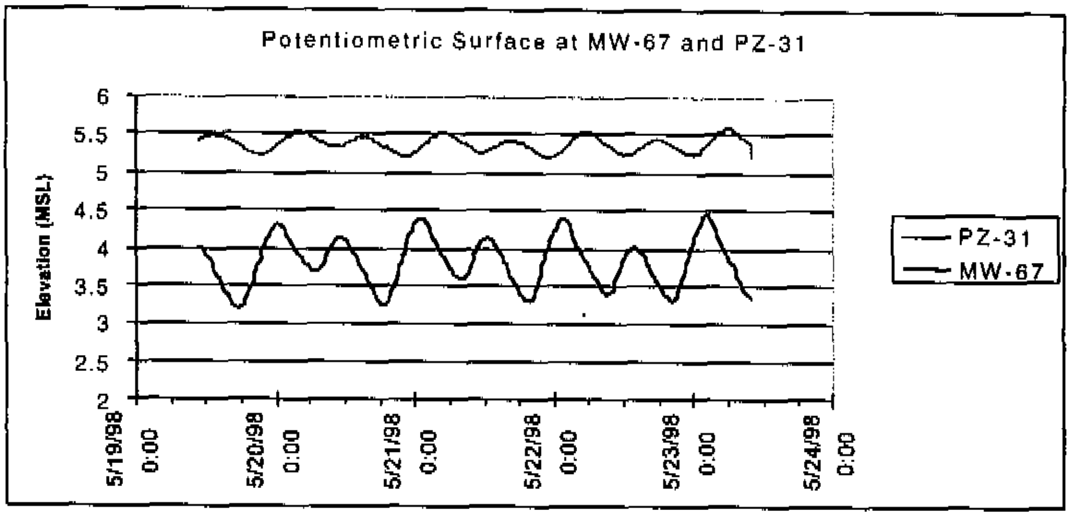
In addition to the site-wide water level measurements, data have been collected that document the tidal variation in the San Joaquin River. A tidal stilling well with a seven-foot PVC well screen was placed in the San Joaquin River near MW-48. This well was used to measure water level in the river and to monitor tidal fluctuations. Data was collected at the stilling well during the verification investigation pump tests and during the 72-hour groundwater well monitoring for the calibration data sets (August 1996 and May 1998). The monitored tidal fluctuations in the river were used in the filtering of the wet season calibration data set and the long-term pumping tests. These data were then used to filter the tidal signal from the tide-induced fluctuations in groundwater elevations.

3.3.4 Tidal Variation in Groundwater Elevations

The following three charts are of the potentiometric surface at MW-67, PZ-31, and a combination of the two for comparison. Both of these monitoring wells are installed in the lowest submember of the Lower Aquifer (L3) and both charts demonstrate tidal fluctuations. The chart for MW-67 shows two high and two low tides per day over three complete tidal cycles. The same pattern exhibited in MW-67 is also shown in the chart for PZ-31, but the amplitude is less, and there is a slight delay in the peaks at PZ-31 as compared to MW-67.







The difference between the tidal responses of the site monitoring wells is largely determined by distance from the discharge point where the tidal fluctuations are emanating from (in this case, the San Joaquin River). The amplitude of tidal fluctuation in site monitor wells is displayed on Figures 3-24 (Upper Aquifer) and 3-25 (Lower Aquifer). Every well on the two figures displayed at least some recognizable tidal cycle that decreased in magnitude with distance from the river and Little Break Marsh. By comparing the two maps it can be observed that the tidal amplitude is slightly greater in the Upper Aquifer for wells closest to the River (compare 2.16' for Upper Aquifer well MW-48 to 2.00' for Lower Aquifer well MW-46). Further away from the river, however, the amplitude of tidal variation in Lower Aquifer wells is higher. This is attributed to the lower storativity and higher transmissivity of the Lower Aquifer that allows the tidal pulse to propagate faster and hence further in the Lower Aquifer than in the Upper Aquifer.

Table 3-6 displays the 1996 tidally filtered water level data and also lists the calculated tidal efficiencies of each well tested. Tidal efficiency is the ratio of the tidal amplitude at the well divided by the tidal amplitude of the tidally influenced water body (in this case the San Joaquin River).

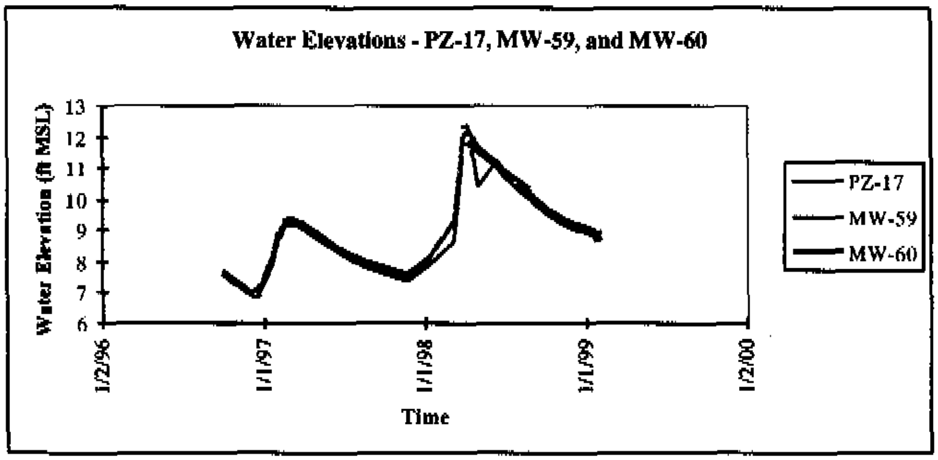
3.3.5 Seasonal Variation in Groundwater Elevations

Almost all of the yearly precipitation average of 17 inches per year falls within the months of October through April, with almost no rainfall in the May to September dry season. Groundwater levels reflect these trends with water levels rising from November through May, and falling until the rainy season begins again in October or November. From late 1997 until early 1999, frequent measurements of water levels were collected to determine the magnitude of seasonal variability in the potentiometric surface.

South Side of Site

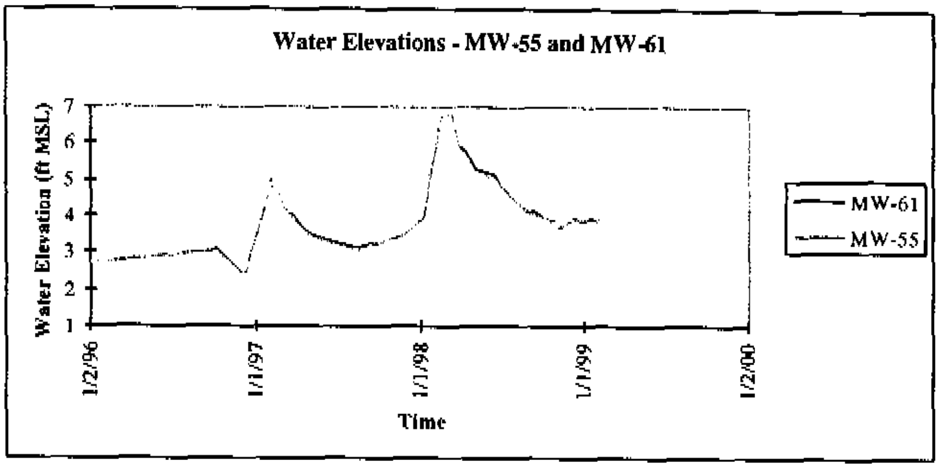
Monitoring well PZ-17 is installed in the Surficial Aquifer just north of Highway 4. The Surficial Aquifer is an unconfined aquifer and this location is hydraulically upgradient of the site. Immediately adjacent to PZ-17 at Highway 4 are MW-59 and MW-60. MW-59 is installed in the Upper Aquifer, which is confined by approximately 10 feet of silty clay. The Upper Aquifer is 34' thick and has five feet of gravely sand at this location. MW-60 is installed in the L1 Sand (uppermost sand unit of Lower Aquifer). Eight feet of silty clay at MW-60 separate the L1 from the Upper Aquifer.

The following chart displays the potentiometric surface over time at PZ-17, MW-59 and MW-60. From late 1997, the water levels increased from about eight feet MSL to just over 12 feet in early 1998 in all three wells. After the early 1998 peak, water level decreased gradually but did not reach the initial readings of 1997. Despite the fact that silty clay layers separate these sand layers, the potentiometric surface in all three wells are the same and exhibit the same seasonal variability.



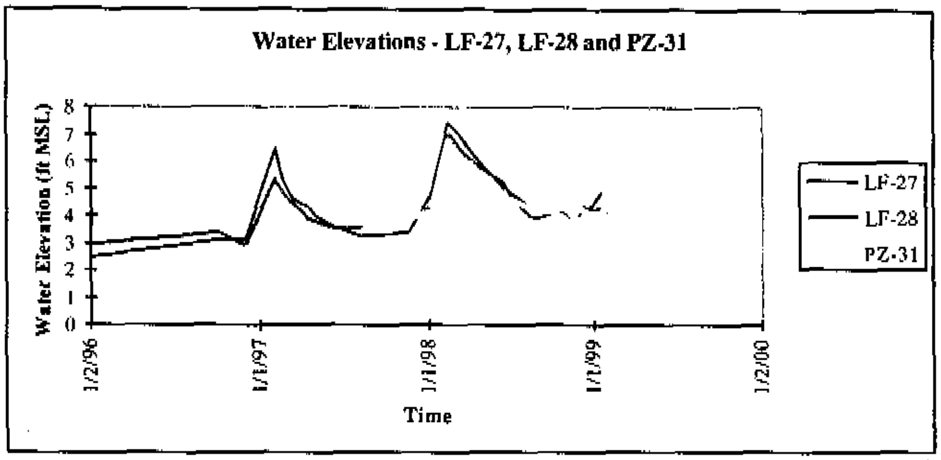
West Side of Site

Monitoring wells MW-61 and MW-55 are at the west edge of the site and are installed in the Upper and Lower Aquifer, respectively. As noted in Section 3.3.1, the U/L Aquitard, which separates the Upper and Lower Aquifers, is thinner than average in this area because the Upper Aquifer is deeper than across most of the site. It is, therefore, not unexpected that the water elevations of MW-61 and MW-55 are practically the same and respond identically to seasonal variation.



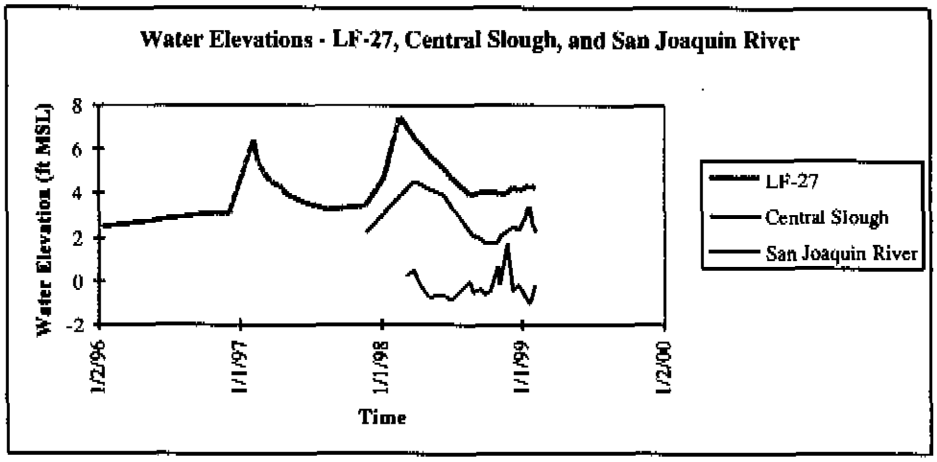
Center of Site

Monitoring wells LF-27 (Surficial Aquifer), LF-28 (Upper Aquifer), and PZ-31 (L3 Sand) are clustered near the south end of the Central Slough about 400 feet north of the former AKC Manufacturing Area. In this area, there is a 15.5 feet thick silty clay (S/U Aquitard) between the Surficial (LF-27) and Upper (LF-28) Aquifers. The U/L Aquitard, however, is only present as silt layers interbedded with fine grained silty sand (PZ-31 log). All three wells show roughly the same seasonal pattern, but there are some differences in water levels over time.



In addition to the long-term monitoring of groundwater elevations, long-term measurements were also made in the Central Slough and in the San Joaquin River (the stilling well). The plot from LF-27 (Surficial Aquifer) is displayed on the following chart with the surface water elevations. It appears, based on the charted data, that the water levels in the Central Slough correlate more closely with groundwater elevations than with water elevations in the San Joaquin River. Because the water elevation is lower in the

Central Slough, it is expected that groundwater discharges to the Central Slough from the Surficial Aquifer.



3.3.6 Potentiometric Surface/ Groundwater Flow

Figures 3-18 through 3-23 confirm that there are significant differences between the groundwater potentiometric surfaces of the aquifers between the dry and wet seasons. Hydraulic gradient is slightly steeper during the wet season, inducing faster groundwater flows. Hydraulic gradients estimated from these potentiometric surface maps are listed in the table below:

Figure	Aquifer	Season	Hydraulic Gradient
3-18	Surficial	Dry	1'/200' or 0.005*
3-19	Surficial	Wet	1.5'/650' or 0.002
3-20	Upper	Dry	~2'/1200' or 0.0017
3-21	Upper	Wet	~2'/1000' or 0.002
3-22	Lower	Dry	~1'/1000' or 0.001
3-23	Lower	Wet	~2'/1000' or 0.002

* The gradient for the Surficial Aquifer in the dry season is questionable as is it based on only a few data points.

The hydraulic conductivities and porosity estimates used in the *Groundwater Modeling Report* (DERS, 1997) are used in the table below to calculate groundwater flow rates from the above-mentioned hydraulic gradients:

Aquifer	Season	Hydraulic Gradient	Hydraulic Conductivity* (ft/d)	Groundwater Flow Rate** (ft/d)
Surficial	Dry	1'/200' or 0.005	80	1.00***
Surficial	Wet	1.5'/650' or 0.002	80	0.46
Upper	Dry	~2'/1200' or 0.0017	101	0.42
Upper	Wet	~2'/1000' or 0.002	101	0.50
Lower	Dry	~1'/1000' or 0.001	144	0.36
Lower	Wet	~2'/1000' or 0.002	144	0.74

* From the March, 14, 1997 *Groundwater Monitoring Report*

** Assuming a porosity of 0.40

*** Questionable result

The Surficial Aquifer shows a substantial difference in water levels, with the wet season potentiometric surface approximately two feet higher near the Central Slough. The potentiometric surface in the Upper Aquifer shows water levels 0.5 to 2 feet higher in the wet season than in the dry season. MW-62 (northwest corner of site) had the greatest difference of 2.44 feet between wet and dry season data, while MW-48 (at the edge of the river) was the same (only a 0.01 foot difference). Results at the "stilling well", which measures the river stage, show that the river was lower when the wet season data were collected. It is believed that since the rainfall had ceased by May, the river had returned to its normal stage. Water levels in the Lower Aquifer are generally 1 to 1.5 feet higher in the wet season data than in the dry season, except near the river where water levels are roughly a foot higher in the dry season (due to the river stage being slightly higher in the dry season). The higher river stage for the dry season is counter-intuitive, but two possible explanations lie in increased run-off from irrigation during the dry season and increased releases from upstream dams on the Sacramento and San Joaquin Rivers.

These differences in the wet and dry season water levels indicate that the hydraulic gradient is significantly greater during the wet season than the dry. Direction of groundwater flow is indicated on the potentiometric surface maps by arrows.

Although the hydraulic gradient is greater by a factor of about two in the Lower Aquifer during the wet season, and groundwater levels are higher in the Upper Aquifer, the gradient in the Upper Aquifer did not change noticeably. According to this comparison, the Lower Aquifer is affected more by the wet/dry seasonal cycle than the Upper Aquifer (because of its higher transmissivity, it could be that most of the surge in groundwater flow during the wet season would travel through the Lower Aquifer).

Three additional groundwater potentiometric surface maps are included as Figures 3-26 through 3-28. These maps are based on a groundwater measuring event in January 2003 as part of the 2002 Annual Report and are described below.

Groundwater flow in the Surficial Aquifer (Figure 3-26) is generally from higher elevations in the south of the site northwards to the San Joaquin River and associated surface water features. Groundwater flow in the surficial aquifer is affected more significantly than groundwater flow in the underlying site aquifers due to the presence of surface water features such as the Lauritzen Yacht Harbor lagoons and Little Break. Groundwater in the northwest portion of the site flows north-northwest toward the San Joaquin River and the Lauritzen Marina lagoons. Flow assumes a much more northeastward component in the vicinity of Little Break.

Groundwater flow in the Upper Aquifer (Figure 3-27) is similar to flow in the Surficial Aquifer, with the predominant flow from south to north in the center of the site while flow in the eastern part of the site is influenced by Little Break. Flow in this area of the site has a more pronounced southwest to northeast flow direction in the Upper Aquifer. Flow in the northwest portion of the site is influenced by the Lauritzen Yacht Harbor lagoons.

Groundwater flow in the Lower Aquifer (Figure 3-28) is generally to the north-northeast, with less influence on water levels by Little Break than is apparent in the Surficial and Upper Aquifers. The Lower Aquifer appears to reflect predominant discharge to and interaction with the San Joaquin River.

3.3.7 Degree of Vertical Connection Between Aquifers

Section 3.3.1 described the thicknesses and character of the two major aquitards at the site, the S/U and U/L Aquitards. It also mentioned that portions of the Lower Aquifer are subdivided into subunits by clay and silt layers that, while not as extensive as the major aquitards, could still influence vertical flow in a limited area.

The most extensive area where the S/U Aquitard appears thinnest is to the east of the former TEL Ponds (such as near GW-02) which was installed across 3.5 feet of silty clay that forms the aquitard. It is, therefore, expected that groundwater in the Upper Aquifer can discharge upward into the Surficial Aquifer and then to Little Break Marsh.

The U/L Aquitard is thinnest along the west side of the site beneath the former CFC Manufacturing Area and west side of the former AKC Manufacturing Area. The Upper Aquifer is deeper in these areas and the Lower Aquifer is at the same depths, therefore, the thickness of the U/L aquitard is reduced. The chart in Section 3.3.5 showing the groundwater elevation data for MW-61 and MW-55 confirms that the Upper and Lower Aquifers may be in communication, because there is virtually no difference between groundwater elevations in the two wells.

Because the Lower Aquifer sometimes contains thin, discontinuous silt or clay layers, it is possible that some variation in potentiometric surfaces might be present in the subunits of the Lower Aquifer (L1, L2, and L3 Sands). There are currently too few clusters of discretely screened Lower Aquifer wells to determine if there are any localized vertical gradients within the Lower Aquifer. After the marsh well installation program (projected for 4Q 2002), this will be evaluated further.

3.3.8 Degree of Aquifer Connection with Surface Water Bodies

The aquifers at the site are connected to the San Joaquin River system and discharge to it. Little Break (including associated channels), the marinas, and the Central Slough are believed to be in contact with the Surficial Aquifer and may be in contact with the Upper Aquifer. A future hydrogeologic investigation in the Central Slough area is scheduled for

2003; based on the results of this study, a similar investigation may be performed to determine the potential for Upper Aquifer discharge to Little Break. The Upper Aquifer discharges directly to the San Joaquin River, while the Lower Aquifer discharges up through the Upper Aquifer and into the San Joaquin River at some distance beyond the shoreline. A numerical modeling effort is planned in 2003 help characterize the discharge of the Lower Aquifer into the San Joaquin River.

The depth to the potentiometric surface in all three aquifers decreases steadily with proximity to surface water bodies, and the gradients are such that the potentiometric surface is equivalent to the water level in the river within several hundred feet of shore. Figure 3-23 for instance shows the water elevation in the river to be 0.58 feet MSL, and 2.52 feet MSL in MW-46 (a L3 Sand Lower Aquifer well). Because the hydraulic gradient in the Lower Aquifer is approximately 2' per 1000' in this figure, the water levels in the river and Lower Aquifer are equal within an approximate distance of 970' [(2.52'-0.58')*1000'/2'] from shore. The same calculations can be performed for the Surficial Aquifer near Little Break Marsh. The hydraulic gradient of 1.5' per 650' (Figure 3-19) is equal to the level in Little Break (assumed to be 0.58' because Little Break has an open connection to the river) at a point approximately 530 feet northeast of PZ-19 [(2.22'-0.58')*650'/2'].

The degree of communication is more difficult to quantify at the marinas and Central Slough because these features are significantly smaller than the river and marsh; however, the figures displaying the magnitude of tidal variation in monitoring wells near the marinas show that the Lower Aquifer wells appear to not be heavily influenced by the marinas, while the Upper Aquifer wells seem to show some influence. Based on the seasonal fluctuations noted in Section 3.3.5, the Central Slough appears to be in contact with at least the Surficial Aquifer because the seasonal water level patterns in the Slough are more similar to those noted in groundwater than in the river.

3.4 Surface Water Hydrology

Major surface water features associated with the site include the Sacramento-San Joaquin Delta (which includes the San Joaquin River), Little Break area, Central Slough, and adjacent marinas. Section 3.4 briefly summarizes available information for these surface water features as well as potential groundwater-to-surface water interactions.

3.4.1 Sacramento-San Joaquin Delta

The Sacramento-San Joaquin Delta (the Delta) encompasses a maze of river channels and diked islands encompassing roughly 738,000 acres in Alameda, Contra Costa, Sacramento, San Joaquin, Solano and Yolo counties (DWR, 1995). The Delta lies at the confluence of the northward-flowing San Joaquin River, southward-flowing Sacramento River, and upper end of the San Francisco Bay estuary. The statutory boundary of the Delta was first determined in 1959 with the passage of the Delta Protection Act (Section 12220 of the Water Code). Figure 3-29 shows the location of the Sacramento and San Joaquin rivers relative to the overall mesh of Delta waterways.

Extensive human modifications to the Delta are well documented (e.g., Nichols, et. al., 1986). Before 1850, approximately 1,400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin rivers. As populations increased, marshes were diked to create farmland and later residential and industrial land. Reclamation of the vast majority of the freshwater marshlands was essentially complete by the early 1920s.

Local tides exhibit a mixed semidiurnal cycle wherein the two high and the two low tides are of unequal height. Typical surface water levels in the Delta vary fairly significantly during each tidal cycle, from more than five feet near Pittsburgh to about 1.5 feet on the San Joaquin River opposite Upper Roberts Island (Figure 3-30).

Freshwater flow is highly variable both within and among years, and has been heavily altered by dams and diversions. The principle flow variables in the Delta are as follows: (1) freshwater inflow (the sum of all the river flows into the Delta); (2) export flow (exportation of water to central and southern California for agricultural and municipal consumption); and (3) net Delta outflow (the difference between inflow and export flows less net consumption in the Delta). According to DWR (1995), the average annual inflow to the Delta was 27,840 thousand acre-feet (TAF) from 1980-1991, with outflow to the San Francisco Bay (21,020 TAF) the major component of Delta water use. The magnitude of average Delta outflows for winter and summer relative to the average tidal flows at the Golden Gate and Chipps Island is, however, small (Figure 3-31). During periods of significant water withdrawal from pumping stations in the vicinity of the site, flow reversal in the San Joaquin River may occur, particluarly during incoming tides.

Much of the land within the Delta is below sea level and relies on levees for protection against flooding. Flood flows reaching the Delta have been estimated to exceed 600,000 cubic feet per second (DWR, 1995). The predicted 100-year flood stage elevation in the vicinity of the site is approximately 6.5 feet above mean sea level (Figure 3-32). The 100-year flood plain limits for the site are depicted in the figures accompanying the EDR reports contained in Appendix 2-1.

3.4.2 Site Hydrology

The San Joaquin River, which borders the site to the north, accounted for approximately 4,300 TAF (25%) of the average inflow to the Delta from 1980-1991 (DWR, 1995). Water depth varies from sea level at the shoreline to about 40 feet below MSL at the thalweg, the deepest part of the river channel. River levels in the vicinity generally vary about three to five feet during a tidal cycle. As shown in Figure 3-33, on a mean lower low water (mllw) basis, water depths opposite the site range from approximately 2 to 18 feet mllw over much of the channel up to approximately 33 feet mllw in the deep water channel.

The Little Break area in the northeastern quarter of the site was historically open water of the San Joaquin River. Subsequent to the area being levied and filled, the lower portions of the basin were inundated with water after the levee was breached. Eventually its current structure of a perimeter levee and smaller islands of emergent vegetation were created. This marsh area is heavily vegetated with tules and other marsh-type vegetation. While a portion of this marsh area is at or near sea level and is inundated at high tide, the majority of the marsh is between one and three feet MSL in elevation and is inundated only during unusually high tide and flood events. Water depths range from ¼ to one-foot mllw in the interior of Little Break to two feet mllw at the inlet (Figure 3-33).

The Central Slough consists of a main channel and several smaller channels and trenches surrounded by wetlands. The water body is shallow and tidally affected. The Central Slough is connected to Little Break by a surface water conveyance system consisting of mostly of open canals/ditches, with culverts emplaced to permit flow underneath aboveground obstructions (see Figure 2-4). A flapper gate is located approximately 250 feet east of the Central Slough, designed to allow surface water from the Little Break area to enter the Central Slough (but not vice versa).

The marinas are embayments that have been dredged approximately 20 feet into the soil. Boring logs of soil borings adjacent to the Lauritzen Yacht Harbor indicate that approximately one to two feet of clay exists between the bottom of the marina excavation and the top of the Upper Aquifer.

3.4.3 Groundwater-Surface Water Interactions

Available stratigraphic, bathymetric, and potentiometric data indicate several possible groundwater-to-surface water discharge areas associated with one or more site aquifers (Figure 3-34):

- San Joaquin River – Surficial, Upper, and Lower Aquifers
- Little Break – Surficial and Upper Aquifers
- Central Slough – Surficial Aquifer
- Marinas – Surficial and Upper Aquifers

Relevant cross-sections are presented in Figures 3-3 and 3-4. Groundwater potentiometric surfaces for the three site aquifers are presented in Figures 3-18 through 3-23, and Figures 3-26 through 3-28.

The Surficial and Upper Aquifers are assumed to be in communication with the San Joaquin River at or near the southern shoreline given the elevation of the top of the Upper Aquifer (-10 feet MSL) and the associated bottom of the San Joaquin River (-10 feet MSL within 50 feet of shoreline). The elevation of the top of the Lower Aquifer near the San Joaquin River (-35 to -40 feet MSL) indicates a likely direct connection with the river at the dredged ship channel. Although the Little Break area is relatively shallow in depth, groundwater potentiometric surfaces indicate that the Surficial and Upper Aquifers are likely in communication with this water body.

Available potentiometric data also indicate that the Surficial Aquifer may be discharging to the Central Slough. The Upper and Lower Aquifers, however, do not appear to be in communication with the Central Slough based on stratigraphic and hydrologic data. The Surficial Aquifer is assumed to be in communication with the marinas, while the Upper Aquifer is likely in communication with the marinas because of enhanced leakage between aquifers due to excavation. The marinas do not appear to be in communication with, or have an impact on, water levels in the Lower Aquifer.

The exact magnitude of potential groundwater discharge into these water bodies is not known at this time, and is expected to vary both on a seasonal basis and with the tides.

3.5 Groundwater Monitoring Program

3.5.1 Groundwater Monitoring Well Network

Groundwater monitoring at the Oakley site began in the early 1980s when the first wells were installed at the site. Since that time many additional wells have been installed and the conceptual hydrogeologic model modified several times. Figures 3-35 through 3-37 indicate the well locations for the Surficial, Upper, and Lower aquifers, respectively. Currently, there are 170 wells installed at the site, with 8 additional wells scheduled to be installed in November 2002 and a further 12 wells to be installed in 2003. Of these, 54 are Surficial Aquifer wells, 61 are Upper Aquifer wells, and 87 are Lower Aquifer wells as is shown in Table 3-7. Specific well construction details, dates constructed, screened intervals and other pertinent data are shown in Table 3-8. In addition, well logs for all site wells are included in Appendix 3-3. The following wells have been plugged and abandoned:

Plugged and Abandoned Wells

MW-01, MW-02, MW-03, MW-04, MW-05, MW-06, MW-07, MW-08, MW-09, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, MW-18A, MW-18, MW-19A, MW-19, MW-20, MW-20A, MW-21, MW-22, MW-23, MW-24, MW-25, MW-26, MW-27, MW-28, MW-29, MW-33, MW-34, MW-51, GW-07, GW-09, GW-10, LF-35

No well logs exist for MW-01 through MW-17 and MW-21 through MW-34. No figure exists to show their physical location.

Groundwater Well Data

Existing groundwater well monitoring data for the Oakley site are contained in Appendix 3-7. These data were collected from January 1988 through July 2002. The data are presented by aquifer, with the constituents presented alphabetically across the page, and detections highlighted. These data are also presented graphically in Appendix 3-8. The constituents presented in Appendix 3-8 represent those constituents that were detected two or more times at a particular well.

Groundwater Elevation Data

Cumulative groundwater elevation data and well hydrographs are included as Appendix 3-9.

3.5.2 Discrete Groundwater Sampling

DuPont has made extensive use of direct push technology in its site exploration activities including CPTs for lithologic characterization and Hydropunch™ for collection of discrete groundwater samples. The location of all CPTs are shown in Figure 3-38, while the names, dates collected, and investigation in which they were collected are shown in Table 3-9 for each CPT. The CPT logs themselves are contained in Appendix 3-5. The discrete groundwater data collected during these investigations are contained in Appendix 3-10. This appendix contains the depth collected, sample ID, date collected, and analytical data results for all discrete groundwater samples, collected mainly via Hydropunch™.

3.5.3 Groundwater Monitoring Plan (GWMP)

Groundwater monitoring began at the Oakley site in the early 1980s and has continued through the present. Initial efforts focused on evaluating releases and delineating the extent of contamination. The most recent version of the MRP included monitoring 48 wells in a broad east-west arc across the site coincident with the location of the GWTF extraction wells. Monitoring efforts focused on evaluating the efficacy of this system, which has been discontinued (see Section 7.1). Wells were sampled semi-annually for lead, VOCs, fluoride, and arsenic. Groundwater elevation data were also collected on a semi-annual basis.

To replace the former Monitoring and Reporting Program, DuPont has proposed a Draft GWMP for DTSC review. This proposal is based on the following monitoring objectives:

- Plume Characterization – Plume characterization will involve monitoring upgradient and downgradient of known plume sources. In addition, monitoring will occur along a transect parallel to the main plume flow and transport axis. This monitoring will be used to evaluate plume stability and overall changes in plume characteristics. Monitoring points will be established as near to the downgradient extent of the plume as possible to monitor potential changes in plume extent and concentration. Monitoring points also will be established within the plumes to obtain sufficient data to support preparation of plume extent maps on a quarterly basis and to assess concentration trends throughout the plume.
- Background Monitoring – Monitoring of wells upgradient of the releases to groundwater will serve as the basis for determining the background concentrations of inorganic constituents in groundwater. The locations of these background monitoring wells will be determined as part of the Groundwater RFI Workplans.
- Remedial Alternatives –Monitoring of wells will be performed to support selection of remedial alternatives and to evaluate potential remedies.
- Article 6 Monitoring—All regulated units at the site are subject to the monitoring requirements identified under California Code of Regulations, Ttitle 22, Sections 66265.90 through 66265.99 (Article 6). These requirements, addressed on an interim basis by the *Groundwater Monitoring Plan*, will be fully addressed by the time of the submission of the upcoming post-closure permit application.
- Newly Installed Wells – Existing and proposed newly installed wells will be sampled quarterly for four consecutive quarters.
- Piezometric Surface Monitoring – Piezometric monitoring locations will be established so that quarterly groundwater level measurements can be taken and a representative groundwater flow map established for the site.

The proposed plan consists of sampling up to 144 monitoring wells distributed within the Surficial, Upper, and Lower aquifers, including 32 monitoring wells as part of the Article 6 monitoring requirements. A total of 122 monitoring wells are included to facilitate the development of site-wide potentiometric surface maps for each the site aquifers. Sampling for the first quarter 2003 will occur in January and includes sample collection at 127 wells. The COPCs in the Interim GWMP are based on the particular plume and area that the well is located in, pending a Final GWMP in 2003/2004. Analytical methods used are designed to attain detection limits consistent with the CVRWQCB's Water Quality Objectives (WQOs) specified by the State of California and shown below:

Constituent	California WQO Micrograms per Liter (ug/L)
CT	0.1
TCM	1.1
1,2-DBA	0.0097
1,2-DCA	0.4
1,4-Dioxane	3
CFC-11	0.19
CFC-113	1200
Lead	2.0
Methylene chloride	2.5
PCE	0.06
Organo lead	0.0007*
TCE	0.8
Vinyl chloride	0.024

* Current analytical methods are not capable of attaining detection limits at this level; the revised California LUFT Method sets organo lead detection limits at 2.0 ug/L.

Pending agreement with the DTSC, DuPont will begin sampling under this plan in late 1Q 2003. The sampling program will include Appendix IX constituents that might be found in groundwater. Data from the groundwater sampling will be used in conjunction with the updated CSM to design an appropriate Final GWMP in 2003. As part of the Interim GWMP, DuPont will submit a list of site wells to plug and abandon.

4.0 DEVELOPMENT AREA SWMU AND AOPC EVALUATION

The property currently owned by DuPont has been subdivided into three Development Areas and a separate wetlands area for evaluation of soil, soil gas, and sediment contamination. This division is based in part on the redevelopment plans of the City of Oakley which prioritize development south of the Wilbur Avenue extension and along Bridgehead Road. The Western and Eastern Development Areas consist of relatively uncontaminated areas of the site such as current and former vineyards, the administrative building, parking lots, etc. (Figure 1-2). The Northern Development Area consists of the former CFC Manufacturing Area, the former AKC Blending Area, and the closed surface impoundments (Figures 1-2 and 2-2). The Southern Development Area consists of the area just north of the plant rail spur extending south through the AKC Manufacturing Area, the TiO_2 Manufacturing Area, and the Manufacturing Support Area to the main rail line along the southern property boundary (Figures 1-2 and 2-2). For each of the above areas, the status of the existing SWMUs, AOPCs, and RCRA-regulated units will be presented. Discussions will include the unit's history, physical location and dimensions, investigation history, and contaminated media. A detailed discussion about contaminated media is presented in Section 5.

4.1 Western and Eastern Development Areas

The boundaries of the Western and Eastern Development Areas are shown in Figure 4-1. This area encompasses current and former vineyards, site administrative offices, parking areas, and the site electrical substation. A due diligence investigation of this area performed in 2001 indicates that soils are uncontaminated by former operations at the site. With respect to groundwater, the western edge of Plume 1 extends beneath the northeast portion of the Western Development Area. The Eastern Development Area was used as overflow parking by Big Break Marina. No sampling has been performed in this area. Two AOPCs, the Electrical Substation and the Sierra Crete™ Roads, exist in the Western Development Area.

4.1.1 Electrical Substation (AOPC 1.1)

Unit History and Description

The Electrical Substation shown in Figure 4-1 was built in 1955 and is still in use. It is the site's connection to the regional power grid and used transformers containing PCBs in the past. A description, data summary, and the status of this area are contained in Table 4-1.

COPCs

Potential COPCs are PCBs.

Investigation History

Four soil borings were performed in the vicinity of the Electrical Substation (RB-042 through RB-045). Surface soil (0 feet to 2 feet bgs) samples were collected from each boring and analyzed for Method 8260B volatiles, Method 6010B RCRA metals, and Method 8082 PCBs. PCBs were not detected, while lead and cadmium were detected at levels marginally above concentrations observed in areas of the facility not related to chemical manufacting and handling (see Table 4-1).

Status

The Electrical Substation is not a SWMU and needs no formal closure.

Potentially Contaminated Media

There are no contaminated media for this area.

4.1.2 Sierra Crete™ Roads (AOPC 1.2)

Unit History and Description

There are four Sierra Crete™ road segments located in the Western Development Area, two of which are in the vineyard north of the Santa Fe/Burlington Northern Railroad tracks and two others located just south of the Electrical Substation. The roads are of varying lengths, widths, and thicknesses.

Note: The term "Area of Potential Concern" (AOPC) is a regulatory designation pertaining to non-regulated areas that may require further investigation or other action. Designating the on-site Sierra Crete™ test roads as AOPCs does not imply that they represent an unacceptable risk to human health or the environment. Rather, it is a way of ensuring that they will be adequately addressed as part of the corrective action process.

COPCs

COPCs for this AOPC include barium, chromium, cobalt, copper, inorganic lead, iron, manganese, nickel, thallium, vanadium, PCBs, hexachlorobenzene, pentachlorobenzene, and dioxins and furans.

Investigation History

The two roads in the vineyard were first investigated during due diligence investigations in 2001. A description and status of this unit is summarized in Table 4-1.

Status

The subbase material has been sampled and the data included in Appendices 5-1a and 5-1b. These data will be evaluated for sufficiency, and if sufficient, compared to RBSCs to determine if further action is warranted.

Potentially Contaminated Media

Road base material and its interface with soil are the potentially contaminated media.

4.2 Northern Development Area

The boundaries of the Northern Development Area are shown on Figure 4-2. The area encompasses the closed surface impoundments (TEL Ponds A, B, and C; East, West, and Emergency Basins), the CFC Manufacturing Area and the portion of AKC Manufacturing

Area north of the plant rail spur. The primary soil investigations were the 1996 and 1997 Phase I and II Soil and Groundwater Investigations which were a SWMU-focused equivalent of a Phase I RFI. Soil contamination is known to be present in the CFC Manufacturing and AKC Manufacturing Areas, while contaminated soils and sediments were excavated from the closed surface impoundments. Groundwater contamination occurs throughout the Northern Development Area.

4.2.1 East and Emergency Basins (SWMU 4.1 and 4.3)

Unit History and Description

The East Basin and Emergency Basins were built in the early 1960s as unlined earthen basins and used as part of the facility's wastewater treatment process (see Figure 4-2). The units received wastewater from all three manufacturing processes and would potentially have COPCs from each of the manufacturing areas. The basins were closed according to a closure plan approved by the DOHS, CVRWQB, and the DTSC.

The closure plan was initially approved by the DOHS on July 17, 1983. This closure included excavating sludge and contaminated soils from the basins and backfilling with clean soil, for a total of 18,100 cubic yards excavated and disposed off-site (the original plan had called for removal of 13,500 cubic yards, but sampling results indicated the need to excavate a larger area). Following excavation, 50 tons of agricultural lime was applied to the Emergency Basin, after which both basins were backfilled with 50,000 cubic yards of clean fill. In all, 11,230 cubic yards of contaminated soil beneath the sludge was removed and disposed off-site. This corresponds to an average excavation depth of 14 inches compared to the original estimate of 4,500 cubic yards or six inches average soil excavation. Waste and soil were removed to meet a closure standard of 1000 mg/kg total lead and 13 mg/kg organo lead. A description and status summary for these units is contained in Table 4-1.

Closure was completed on April 30, 1985. An independent registered Civil Engineer provided closure oversight. Closure certification was submitted by the plant and the independent registered engineer to the CVRWQB and the DTSC on May 3, 1985. DTSC certified closure in a letter dated October 31, 1985.

COPCs

COPCs for these units include VOCs, kerosene, organo lead, arsenic, barium, chromium, cobalt, copper, fluoride, inorganic lead, iron, manganese, nickel, thallium, vanadium, PCBs, hexachlorobenzene, pentachlorobenzene, and dioxins and furans.

Investigation History

These units were sampled as part of the closure activities, with the lead and organo lead analyses done at the onsite plant lab. Statistical analysis of confirmatory sampling was performed to show that concentrations were below the closure standard.

Status

The SWMUs were closed under a Closure Plan approved by both the CVRWQB and the DTSC with closure certified by the DTSC on October 31, 1985. Contaminated soil and sludge were excavated and replaced with clean soil. The status of these units as groundwater contaminant sources will be evaluated as part of the ongoing site characterization efforts. The units will be subject to California Code of Regulations, Title 22, Article 6 monitoring requirements. No further soil sampling is recommended since closure required excavating waste and soil to meet a regulatory standard, which was verified before the basins were backfilled with clean fill. A description and status of these units is shown in Table 4-1.

Potentially Contaminated Media

Soil contamination has been addressed by the closure and removal activities. The units will be evaluated to determine whether there is a continuing release to groundwater.

4.2.2 West Basin (SWMU 4.2)

Unit History and Description

The West Basin was built in the early 1960s as an unlined earthen basin and used as part of the facility's wastewater treatment process (see Figure 4-2). The unit received wastewater from all three manufacturing processes and would potentially have COPCs from each of the manufacturing areas. The basin was closed according to a closure plan approved by the CVRWQB and the DTSC, which included excavating sludge and contaminated soils from the basin to meet a closure standard of 1000 mg/kg total lead and 13 mg/kg organo lead. A description and status of this unit are shown in Table 4-1.

Closure was completed on April 30, 1985. An independent registered Civil Engineer provided oversight for the closure. Closure certification was submitted by the plant and the independent registered engineer to the CVRWQB and the DTSC on May 3, 1985.

After closure, the West Basin was renamed as the Holding Basin and was put back into use as part of the wastewater management system under the site's NPDES Permit. It was divided into two separate ponds which held treated process wastewater and stormwater prior to pH trim and discharge to the San Joaquin River.

COPCs

COPCs for this unit include VOCs, kerosene, organo lead, inorganic lead, antimony, arsenic, fluoride, and potentially, barium, chromium, cobalt, copper, iron, manganese, nickel, thallium, vanadium, PCBs, hexachlorbenzene, pentachlorobenzene, dioxins and furans.

Investigation History

This unit was sampled as part of the closure activities, with the lead and organo lead analyses done at the onsite plant lab. Settled solids have accumulated in this unit since after closure, but these materials have not been sampled to date.

Status

This SWMU was closed under a Closure Plan approved by both the CVRWQB and the DTSC. Closure was certified by the DTSC on October 31, 1985. Contaminated soil and sludge were excavated prior to the basin being returned to use as a holding basin in the NPDES-permitted discharge system. The settled solids that have accumulated in this unit after closure and while in use as the Holding Basin have not been characterized. The status of this unit as a groundwater contaminant source will be evaluated as part of the ongoing site characterization efforts. The unit will be subject to California Code of Regulations, Title 22, Article 6 monitoring requirements.

Potentially Contaminated Media

Contamination relating to operations between the early 1960s and closure in 1985 was addressed by closure and removal activities. The settled solids that have accumulated since closure will be evaluated and addressed as part of the overall corrective action program at the site.

4.2.3 TEL Ponds A, B, and C (SWMU 4.4, 4.5, and 4.6)

Unit History and Description

The TEL Ponds were built in the 1970s to store sludge from the AKC manufacturing process. TEL Ponds A, B, and C were surface impoundments with a polyethylene liner base and four inches of reinforced concrete overlying the liner (see Figure 4-2 and 5-2). The units received sludge and waste lead solids from the AKC manufacturing process (see Section 4.2.17 for further details). Concrete-lined trenches permitted flow into and out of these ponds, which connected to the Northern Trench System. The basins were closed according to a closure plan approved by the CVRWQB and the DTSC. Because the TEL Ponds were lined basins, no confirmatory samples were collected and no soils from beneath the units were excavated. Sludge was removed from the units, reprocessed, or sent off-site for disposal. After removal of the sludge, the ponds were backfilled with clean fill. The description and status of these units are shown in Table 4-1.

Closure was completed on April 30, 1985. An independent registered Civil Engineer provided oversight for the closure. Closure certification was submitted to the two agencies on May 3, 1985 by the plant and an independent registered engineer. DTSC certified closure for these units in an October 31, 1985 letter.

COPCs

The COPCs associated with these units are those from the AKC manufacturing process: organo lead, inorganic lead, 1,2-DCA, and 1,2-DBA.

Investigation History

Results were reported in the Closure Report, dated May 3, 1985. No confirmatory sampling was performed as these units were lined basins. The Source Area investigation collected groundwater data in this area.

Status

These SWMUs have been closed under a Closure Plan approved by both the CVRWQB and the DTSC with the closure certified by the DTSC on October 31, 1985. The ponds were backfilled with clean soil. The status of these units as groundwater contaminant sources will be evaluated as part of the ongoing site characterization efforts. The units will be subject to California Code of Regulations, Title 22, Article 6 monitoring requirements. No further soil sampling is recommended.

Potentially Contaminated Media

Soil contamination was addressed by closure and removal activities. The units will be evaluated to determine whether there is a continuing release to groundwater.

4.2.4 TEL Blender Trap, TEL Blender Sump, and TEL Tanks Area (SWMU 4.7, SWMU 4.8, and AOPC 2.2)

The TEL Blender Trap and TEL Blender Sump were part of the same blending process at the TEL Blending facility. These units managed the same wastes and are located in close proximity; therefore, they will be managed as one unit for future evaluation and closure activities. In addition, several AKC storage tanks were located just north of these units during the life of the AKC manufacturing operation. Investigation and evaluation of the tank area will be included with the other two units due to their proximity and the similarity of the COPCs in each unit.

TEL Blender Trap (SWMU 4.7)

This unit operated from 1957 to 1981 and was used to manage wastewater from the TEL blending operation. The unit was closed by removal in 1987. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

The TEL Blender Trap was an underground sump constructed of six-inch reinforced concrete measuring 6 feet x 3 feet x 5 feet deep. The general location of this unit is north of 6th Street and east of B Avenue (Figure 4-2). The concrete structure for this unit was removed and disposed of, but no data exist to indicate whether any soil excavation occurred during the removal activities.

TEL Blender Sump (SWMU 4.8)

This unit operated from 1957 to 1981 and was used to manage wastewater from the TEL blending operation. The unit was closed by removal in 1987. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

The TEL Blender Sump is described as an underground sump constructed of eight-inch reinforced concrete measuring 12 feet x 9 feet x 5 feet deep. The general location of this unit is north of 6th Street and east of B Avenue (Figure 4-2). The concrete structure for this unit was removed and disposed, but no data exist to indicate whether any soil excavation occurred during the removal activities.

TEL Tanks Area (AOPC 2.2)

The TEL Tank Area consists of a series of large above ground tanks used during the operating life of the AKC Manufacturing Area. No spills are documented, but groundwater contamination identified during the Source Area Investigation has caused this area to be identified as an AOPC. It is located near the TEL Blender Trap, TEL Blender Sump, and the Trench System. A description and status of this unit are shown in Table 4-1.

COPCs

COPCs for these units are organo lead, inorganic lead, VOCs (1,2-DCA, 1,2-DBA, and xylene), and kerosene.

Investigation History

These units (SWMUs 4.7 and 4.8) were investigated during the *Source Area Investigation* and the Phase I Soil and Groundwater Investigation. Results of these investigations are contained in Appendices 3-7 and 3-10. No soil sampling has been performed in the AKC Tank Area (AOPC 2.2).

Status

Both the TEL Blender Sump and the TEL Blender Trap are SWMUs that have documented releases. These units will be carried forward for the Phase I Soil RFI Work Plan. The AKC Tank Area is not a SWMU and needs no formal closure; however, this area needs further characterization and evaluation to allow redevelopment to proceed. All three units will be combined and investigated as one entity in future soil investigations due to their proximity and their identical list of COPCs.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.5 Wash Pad Sump (SWMU 4.9)

Unit History and Description

The Building 48 Wash Pad Sump is identified as the decontamination pad wastewater collection sump. The pad was used for decontamination of equipment used in the TEL blending operation. This unit operated from 1957 to 1981 and was closed by removal in 1987. Description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

The wash pad sump is described as an underground sump constructed of six-inch reinforced concrete measuring 4 feet x 4 feet x 4 feet deep. The general location of this unit is north of 6th Street and south-southeast of the Central Slough. The concrete structure that formed this unit has been removed, but it is not known whether any soil removal and disposal occurred during the closure activities.

COPCs

Materials managed by the unit include inorganic and organic lead, and kerosene, along with the VOCs (PCE, toluene, xylene, 1,2-DCA, and 1,2-DBA).

Investigation History

This unit was investigated during the 1996 *Phase I Soil and Groundwater Investigation*, with two soil borings performed and three samples collected from each boring. A summary of the data collected during this investigation is shown in Table 4-1. The analytes detected include PCE, toluene, xylenes, CFC-113, TEL, and lead.

Status

The original structure for this unit has been removed. Samples were collected as part of the *Phase I Soil and Groundwater Investigation* that indicate a release occurred. Further investigation of this unit will occur in the Phase I Soil RFI.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.6 Building 50 Sump and Lead Recovery Unit (SWMU 4.10 and SWMU 4.15)

Unit History and Description

These two units are located in close proximity and were involved in the lead recovery operations in Building 50. The current information on each unit is presented below. The data collected to date will be evaluated as one unit, and future investigations will treat these units as one for evaluation and closure activities.

Building 50 Sump (SWMU 4.10)

This unit was used for storage of wastewater generated in the AKC manufacturing process. This unit operated from 1957 to 1984 and was closed by removal in 1987. Upon removal of the concrete structure, confirmatory samples were collected from surrounding soils and compared to the closure standards used in the closure of the Basins and TEL Ponds (500 mg/kg lead and 13 mg/kg organo lead). The 500 mg/kg level for inorganic lead used as the clean-up standard is lower than the standard used for the Basins and TEL Ponds closure. Two out of six soil samples collected around this unit exceeded these standards. A total of 231 cubic feet of soil was removed. No official closure of this unit was obtained from the regulatory agencies. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1. Results for the confirmatory sampling are not shown as the soils sampled were excavated and disposed off-site, but results from the Phase I Soil and Groundwater Investigation are summarized.

The unit is described as an underground sump constructed of six- to eight-inch reinforced concrete measuring 8 feet x 5 feet x 5 feet deep. The general location of this unit is east of the TEL blending area and north of 6th Street and the railroad spur (see Figure 4-2).

Lead Recovery Unit (SWMU 4.15)

This unit was used to reclaim organo lead from lead sludge generated in the AKC manufacturing process. The reclaimed material was mixed with virgin organo lead and sold to refineries as gasoline additive. The remainder of the sludge was converted into a product containing inorganic lead and was then sold to secondary lead refiners to produce metallic lead.

The unit operated from 1957 to 1982 and was closed by removal in 1987. Description and status of this unit are shown in Table 4-1. No confirmatory soil samples were collected. The general location of this unit is north of 6th Street and north of the railroad spur (see Figure 4-2).

COPCs

COPCs for this unit are organo lead, inorganic lead, 1,2-DCA, and 1,2-DBA.

Investigation History

These units were investigated during the 1996 Phase I Soil and Groundwater Investigation. Soil samples were collected at five locations, with three samples collected from each location. Results are summarized in Table 4-1.

Status

Building 50 Sump was removed and soil excavated to meet the closure standards; however, no regulatory agency certified that the unit was closed. The Lead Recovery Unit was not closed or excavated. Both units will be carried forward into the Phase I Soil RFI and will be treated as one unit for evaluation and closure.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.7 Building 41 East, West, Surge, and Backwash Sumps (SWMUs 4.11, 4.12, 4.13, and 4.14)

Unit History and Description

These four units were part of Building 41 operations and managed the same waste streams and constituents. They will be discussed together below and addressed together in future investigations. The dimensions and investigation history will be discussed separately for each SWMU below and are summarized separately in Table 4-1.

East Sump (SWMU 4.11)

This unit was used for storage of wastewater generated in the AKC manufacturing process. This unit operated from 1957 to 1981 and was closed by removal in 1987. Upon removal of the concrete structure, confirmatory samples were collected from surrounding soils and compared to the closure standards used in the closure of the Basins and TEL Ponds (1000 mg/kg lead and 13 mg/kg organo lead). None of the five soil samples collected during removal exceeded these standards. In all, 248 cubic feet of soil were removed during demolition of this unit. No official closure of this unit was obtained from regulatory agencies. Results from the confirmatory sampling were not retained in site records as the soils sampled were excavated and disposed off-site, but results from the Phase I Soil and Groundwater Investigation are summarized (see Table 4-1).

The unit is described as an underground sump constructed of eight-inch concrete measuring 20 feet x 12 feet x 8 feet deep. The general location of this unit is north of 6th Street and north of the railroad spur (Figure 4-2).

West Sump (SWMU 4.12)

This sump was used for storage of wastewater generated in the AKC manufacturing process. This unit operated from 1957 to 1981 and was closed by removal in 1987. Upon removal of the concrete structure, confirmatory samples were collected from surrounding soils and compared to the closure standards used in the closure of the Basins and TEL Ponds (1000 mg/kg lead and 13 mg/kg organo lead). Three samples out of the nine collected exceeded these standards. A total of 1,030 cubic feet of soil was removed. No official closure of this unit was obtained from regulatory agencies. Results for the confirmatory sampling are not shown in Table 4-1 as the soils sampled were excavated and disposed off-site, but results from the Phase I Soil and Groundwater Investigation are summarized.

The unit is described as an underground sump constructed of eight-inch reinforced concrete measuring 28 feet x 15 feet x 8 feet deep. The general location of this unit is north of 6th Street and the railroad spur (see Figure 4-2).

Surge Sump (SWMU 4.13)

This sump was used for storage of wastewater generated in the AKC manufacturing process. This unit operated from 1957 to 1981 and was closed by removal in 1987. Upon removal of the concrete structure, confirmatory samples were collected from surrounding soils and compared to the closure standards used in the closure of the Basins and TEL Ponds (500 mg/kg lead and 13 mg/kg organo lead). The 500 mg/kg level for inorganic lead used as the clean-up standard is lower than the standard used for the Basins and TEL Ponds closure. Five out of thirteen soil samples collected around this unit exceeded these standards. A total of 1,430 cubic feet of soil was removed. No official closure of this unit was obtained from the regulatory agencies. Results for the confirmatory sampling are not shown in Table 4-1 as the soils sampled were excavated and disposed off-site, but results from the Phase I Soil and Groundwater Investigation are summarized.

The unit was constructed of 12-inch reinforced concrete measuring 34 feet x 20 feet x 9 feet deep. The general location of this unit is north of 6th Street and north of the railroad spur (Figure 4-2).

Backwash Sump (SWMU 4.14)

This sump was used for storage of wastewater generated in the AKC manufacturing process. This unit operated from 1957 to 1981 and was closed by removal in 1987. Upon removal of the concrete structure, confirmatory samples were collected from surrounding soils and compared to the closure standards used in the closure of the Basins and TEL Ponds (500 mg/kg lead and 13 mg/kg organo lead). The 500 mg/kg level for inorganic lead used as the clean-up standard is lower than the standard used for the Basins and TEL Ponds closure. Two soil samples out of eight exceeded these levels. A total of 924 cubic feet of soil was removed. Results of the confirmatory sampling are not shown in Table 4-1 as these soils were excavated and disposed off-site, but results from the Phase I Soil and Groundwater Investigation are summarized.

The unit is described as an underground sump constructed of eight-inch reinforced concrete measuring 16 feet x 8 feet x 7 feet deep. The general location of this unit is north of 6th Street and the railroad spur (Figure 4-2).

COPCs

Materials managed in the four sumps are not defined; however, possible constituents include inorganic and organic lead, chloroethane, 1,2-DCA, 1,2-DBA, and PCE.

Investigation History

Each of these four units were investigated in the *Phase I Soil and Groundwater Investigation* in 1996. Eight samples were collected in and around these units, with the results listed in Table 4-1, along with unit status and description.

Status

The original structures for these units have been removed, contaminated soils excavated and confirmatory samples collected. No closure has been approved, and additional samples were collected as part of the Phase I Soil and Groundwater Investigation (Table 4-1). Further investigation of these units will occur in the Phase I Soil RFI, with all four units treated as one for investigation and evaluation purposes.

Potentially Contaminated Media

Potentially contaminated media are soils and groundwater.

4.2.8 Limestone Treatment Box (SWMU 4.16)

Unit History and Description

This unit operated from 1957 to 1987 and was used to neutralize acid wastes from the Freon® manufacturing processes. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1. The unit was an underground wooden structure located in the Freon® area (Figure 4-2). Wastewater from scrubbers used for fume collection and other sources was conveyed through the unit. The unit was filled with limestone for neutralization and the effluent from the unit was conveyed to the West Basin. Spent limestone from the unit contained fluoride and was generated at an average rate of five tons per year with the material placed in drums and disposed off-site in a Class I disposal site. Details on the dismantling of the unit are not available, but the probable procedure was removal of the limestone and backfilling to grade. The wooden structure was not removed. The unit is located south of the Fluoride Tank area (within the CFC Manufacturing Area).

COPCs

COPCs for this unit are fluoride, arsenic and VOCs (CFC products, CT, etc.) related to the CFC manufacturing process.

Investigation History

This unit was investigated during the *Phase II Soil and Groundwater Investigation*. At two locations adjacent to this unit, soil samples were collected at three discrete depth intervals. Results from this sampling are summarized in Table 4-1. The 2002 GORE-SORBER® soil gas survey addressed a portion of this area (see Appendix 5-4).

Status

This unit has been investigated during the 1997 *Phase II Soil and Groundwater Investigation*. Results indicate that a release has occurred; however, data from the GORE-SORBER® soil gas survey (Appendix 5-4) shows that elevated concentrations of CFCs and VOCs are likely associated with other sources and not directly related to the operation of this unit. This unit should be carried forward for additional characterization and evaluation.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.9 Fluoride Storage Tank Unit (SWMU 4.18)

Unit History and Description

The Fluoride Storage Tank Unit was used to store liquid alkaline waste generated by the manufacture of CFCs. It was a 12,000-gallon fiberglass above ground tank within a concrete secondary containment (see Figure 4-2).

The unit was closed to a risk-based standard under a closure plan approved by DTSC. Certification was submitted on March 18, 1997, with approval from the DTSC on January 20, 2000.

COPCs

COPCs for this unit are fluoride, arsenic, and VOCs.

Investigation History

The unit was investigated in 1995 and 1996 under the *Closure Sampling Plan and Amended Closure Sampling Plan.* Results are summarized in Table 4-1. The GORE-SORBER® soil gas survey addressed a portion of this area (see Appendix 5-4).

Status

This unit has been closed to a risk-based standard and deed restricted. The risk-standard applied for this unit may not be appropriate considering that future site uses may differ from those evaluated in the risk assessment dated August 18, 1996. Data from the GORE-SORBER® soil gas survey (Appendix 5-4) shows that elevated concentrations of CFCs and VOCs are likely associated with other sources and not directly related to the operation of this unit. DuPont is considering conducting verification sampling to determine if a release to groundwater has occurred from this unit and subsequently to evaluate whether it is necessary to conduct groundwater monitoring and/or perform correction action to achieve clean closure for this unit.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.10 TiO_2 Waste Storage (SWMU 4.27)

Unit History and Description

The paved area just south of the East Basin was used to temporarily store non-hazardous TiO_2-related wastes. These wastes were stored here temporarily beginning in 1987 and it is not known when this use ceased. No sampling has occurred in this area, but the non-hazardous nature of the materials stored here resulted in a "no further action" determination by the DTSC in the 1993 RFA. No new data are available to indicate that this status should change.

4.2.11 Container Storage Area (SWMU 4.29)

Unit History and Description

The Container Storage Area was an asphalt lined open-air unit within a chain link fence used to store 55-gallon drums of hazardous waste. The unit was later repaved with asphalt and a one-foot high asphalt containment berm was built at the perimeter (see Figure 4-2).

The unit was closed by removing the fence, asphalt pad, gravel subbase, and selected soil based on sampling results. Soil and debris with elevated lead concentrations were disposed of as hazardous material. Sixty-four tons of hazardous materials and 421 tons of non-hazardous materials were disposed off-site.

The unit was clean closed under a closure plan approved by DTSC. Certification was submitted on March 18, 1997 and DTSC certified closure in a letter dated January 20, 2000.

Investigation History

This unit was investigated in 1993 and 1997 and a summary of the results are shown in Table 4-1.

Status

This unit was clean closed after excavation and offsite disposal of contaminated soil. No further action is required.

Potentially Contaminated Media

Soils and debris that were contaminated have been excavated and disposed off-site. No impacted media remain.

4.2.12 Portable Antimony Waste Containers (SWMU 4.30)

Unit History and Description

As per the 1993 RFA from the DTSC, these were containers that were stored in SWMU 4.29 and were addressed during the clean closure of that unit. No further action is warranted.

4.2.13 Asbestos Waste Drum Area (SWMU 4.31)

Unit History and Description

This area was used to store drums containing asbestos. Waste asbestos was placed in double layer plastic bags and then in steel drums. Waste asbestos generated as old insulation was replaced with new, asbestos-free insulation across the site. Waste contained 10 to 20 percent asbestos; reported quantities generated ranged from 1 to 10 tons annually. The exact dates of operation for this unit are uncertain, but the unit is inactive. When adequate quantities were accumulated, the drums were shipped to a Class I disposal facility. The capacity of the unit was 200 drums. No releases were indicated.

COPCs

Asbestos is the only COPC for this SWMU.

Investigation History

This unit was investigated during the Phase II Soil and Groundwater Investigation and was non-detect for all analytes.

Status

No further action is required based on the nature of the materials, their manner of storage, lack of reported releases, and the non-detects from prior soil sampling.

Potentially Contaminated Media

Low potential for contamination to any media.

4.2.14 Acid Digestor (SWMU 4.32)

Unit History and Description

This unit was a 500-gallon fiberglass above-ground tank used to dissolve cloth filter bags from organo lead manufacturing in HCl (see Figure 4-2). A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

The unit was closed on August 15, 1984 according to a closure plan approved by the DOHS. The closure was certified by an independent registered Civil Engineer. No further action is warranted.

4.2.15 Waste Injection Well (SWMU 4.33)

Unit History and Description

The deep waste injection well was used from February 1957 to March 1958 to discharge aqueous sodium chloride solution containing traces of ethyl chloride, organic and inorganic lead. In addition, from March 1970 to August 1981 the well was again used to discharge gaseous hydrocarbons containing ethyl chloride and traces of organic lead. Both discharges originated from the manufacture of organo lead. A permit issued by the CVRWQB regulated the operation of the well. For further discussion and details of the deep well design refer to Section 3.2.2 and Appendix 3-2.

The well was closed on April 8, 1982 according to a closure plan approved by the CVRWQB and the Division of Oil and Gas. The USEPA and the State Resources Control Board were kept informed of the closure activities. The well was filled with cement from the injection zone to the surface; a steel plate was welded on top of the inner seven-inch casing and one on top of the 10-3/4 inch outer casing. The closure was observed and approved by an Area Engineer of the Board staff.

No further action is warranted.

4.2.16 Freon® Manufacturing Area (SWMU 4.42)

This unit lies at the boundary between the Northern and Southern Development Areas. The southern part of this unit, up to the northern boundary of the railroad tracks, will be included in the Southern Development Area while the remaining parts of the Freon® Manufacturing Area will be investigated as part of the Northern Development Area.

Unit History and Description

CFC production began in 1957 and continued until April 1995. CFCs manufactured or packaged at the site included trichlorofluoromethane (CFC-11), dichlorodifluoromethane (CFC-12), chlorodifluoromethane (CFC-22), and trichlorotrifluoroethane (CFC-113). Production ceased in 1995 and the Freon® manufacturing area was dismantled in 1999. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1. The Freon® Manufacturing Area is located in the western portion of the plant (see Figure 4-2). There are two SWMUs located within the Freon® Manufacturing Area: SWMU No. 4.16 - Limestone Treatment Box and SWMU No. 4.18 – the Fluoride Storage Tank Unit (see above).

The manufacture and storage of CFCs and materials used in the production of CFCs were considered a potential source of soil and groundwater contamination. The various CFCs and other VOCs detected in groundwater in the area indicate that this area has released constituents in the past.

COPCs

The COPCs for the Freon® Manufacturing Area are the various CFC products and other constituents related to the process (antimony, arsenic, fluoride and various VOCs).

Investigation History

This area was investigated as part of the *Phase II Soil and Groundwater Investigation*, the *Source Area Investigation*, and the 2002 GORE-SORBER® soil gas sampling. Soil results for the Soil and Groundwater Investigation are shown in Table 4-1, while the results of groundwater sampling are contained in Appendices 3-7 and 3-10 and GORE-SORBER® data in Appendix 5-4.

Status

Releases to soil and groundwater have occurred within this SWMU. Data from the GORE-SORBER® soil gas survey (Appendix 5-4) shows elevated concentrations of CFC-11 and CFC-12 in the western portion of this unit, whereas PCE shows the highest concentrations adjacent to the east side of the Freon Management Building 110, with CT and its degradation product (chloroform) showing elevated concentrations to the south and west of the Freon Manufacturing tank area. Further evaluation is warranted to evaluate the source and extent of contamination.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.17 Northern Trench System (SWMU 4.43a)

The Trench System SWMU will be divided into a Northern Trench System SWMU (SWMU 4.43a) and a Southern Trench System SWMU (SWMU 4.43b) with the characterization, evaluation, and potential remediation driven by the schedule appropriate to the Development Area in which it resides. An overview of the Trench System is shown in Figure 2-4. A more detailed illustration of the Trench System alignment for the Northern and Southern Development Areas is presented in Figures 4-2 and 4-3, respectively. The dividing line between the Northern and Southern Trench systems is the boundary between the Northern and Southern Development Areas.

Unit History and Description

These trenches were used to convey wastewater to the various ponds and holding basins. The trenches originally were constructed as wood-lined trenches that were later upgraded, where necessary, to fibercast trenches. The trenches on the west side of the plant currently remain as open wood-lined trenches while those on the east have been filled with soil. A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

Material of construction for the original trench liners was "Laminex" by Wheeler Lumber Bridge & Supply Corp. Wood was treated with #1 Coal Tar Creosote Oil at 150 PSI. The wastewater ditches were generally 15 inches wide but varied in depth depending upon the slope required to gravity drain from manufacturing areas to the earthen retention basins. Over the years, as the wooden sections deteriorated, fibercast trenches of equal dimensions were used as replacements. In those cases where waste materials had to be moved by pumping, steel pipe or fibercast piping systems were used. As capacity was used up, the TEL Ponds were constructed to add system capacity. Conveyance systems into and out of these ponds consisted of concrete-lined trenches.

The wood-lined trenches originated in each of the site manufacturing areas (i.e., CFC, AKC, and TiO2) within the Northern and Southern Development Areas and converged at the TEL Ponds, and the earthen retention basins (i.e., East, West, and Emergency Basins) in the Northern Development Area. Within the Northern Development Area, the trenches start between 6th and 7th Streets and proceed northward along either D Avenue on the east side of the plant or B Avenue on the west side of the plant (see Figure 2-4). The Northern Trench System also received wastewater generated from within the Southern Development Area (see Section 4.3.15)

East Trench Segment

Two separate trenches parallel D Avenue, and turn westward and parallel South Basin Road. A feeder trench originating in the TEL waste recovery area comes into the east trench segment north of the Acid Digestor and southeast of the Central Slough (Figure 4-2), proceeds northward for discharge into the TEL Ponds, and ultimately into the earthen retention basins. This TEL trench is isolated from the adjacent TiO_2 trench that orginated in the Southern Development Area (see Section 4.3.15). The area of the east trench segment between the TiO_2 area and where the TEL feeder trench joins it did not convey AKC-related constituents and requires analysis of only TiO_2 process-related COPCs.

West Trench Segment

The B Avenue trench received waste streams from both the CFC Manufacturing and TEL Blending Areas, feeding into it at one primary location (Figure 4-2). Additionally, the B Avenue trench received waste streams derived from the AKC Manufacturing Area in Southern Development Area (see Section 4.3.15).

COPCs

COPCs-East Trench Segment

For the TiO_2-only segment of the trench, the COPCs are those related to TiO_2 manufacture including barium, chromium, cobalt, copper, iron, manganese, nickel, thallium, vanadium, dioxin and furans, PCBs, hexachlorobenzene, pentachlorobenzene, and PCE. For the AKC-only segment, COPCs include organo lead, inorganic lead, and VOCs.

COPCs-West Trench Segment

For the trench segment with AKC manufacturing wastes and CFC manufacturing wastes, the COPC list includes VOCs, organo lead, inorganic lead, arsenic, and fluoride.

Investigation History

The 1996 Phase I Soil and Groundwater Investigation addressed this unit. The soil data collected (see Figure 5-2) is shown in Table 4-1, while the groundwater data is contained in Appendices 3-7 and 3-10. The 2002 GORE-SORBER® soil gas survey addressed a portion of the West trench system (see Appendix 5-4).

Status

This unit requires additional characterization and evaluation; although data from the GORE-SORBER® soil gas survey (Appendix 5-4) suggests it is not a major VOC source area as concentrations range from non-detect (i.e., CFC-11, CFC-113, CT, chloroform) to low (i.e., PCE) concentrations of COPCs. Discussions between DuPont and DTSC are currently ongoing to determine how to implement groundwater monitoring for this unit under California Code of Regulations, Title 22, Article 6.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.18 CFC-113 Tank Area (AOPC 2.1)

Unit History and Description

The CFC-113 Tank was located above ground in the northwest corner of the CFC Manufacturing Area and had a reported spill in the mid-1970s (see Figure 4-2). Approximately 50,000 pounds of CFC-113 were reported to have spilled to bare soil. The CFC-113 plume appears to have its main source in the vicinity of this spill (see Section 5.2). There is no documentation of the years of operation. A description and status of this AOPC is shown in Table 4-1.

COPCs

CFC-113 and CFC-11 are the primary COPCs for this AOPC.

Investigation History

A portion of the 2002 GORE-SORBER® soil gas survey addressed this area (see Appendix 5-4) and the Source Area Investigation addressed groundwater contamination in this vicinity (see Appendices 3-7 and 3-10).

Status

This AOPC was not identified as a SWMU. Further characterization of soil and groundwater contamination are needed. An innovative technology, the MIPs will be used in this area in late October 2002 to further characterize vertical distribution of volatile organics. Data from the 2002 GORE-SORBER® soil gas survey (Appendix 5-4) shows elevated concentrations of CFC-113 associated with this tank storage area. MIPs data will be presented in the Groundwater RFI Workplan to be submitted at a later date.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.19 1,2-DCA, 1,2-DBA, Chloroethane, and Kerosene Tanks (AOPC 2.3)

Unit History and Description

This unit consists of four above-ground tanks where various VOC components of AKC were stored for use in the AKC blending process (see Figure 4-2). These tanks were of varying sizes with no reported releases. However, data collected during the Source Area Investigation and the Phase I Soil and Groundwater Investigation indicates that one or more of these tanks may have released to groundwater. The tanks and above ground piping have been removed.

COPCs

COPCs for this unit include inorganic lead, organo lead, 1,2-DCA, 1,2-DBA, chloroethane, and various components of kerosene.

Investigation History

The Source Area Investigation and groundwater well monitoring data indicate a source for 1,2-DCA in this area. In addition, the Phase I Soil and Groundwater Investigation indicated some kerosene-related compounds in soil and groundwater in this area. A description and status of this AOPC is shown in Table 4-1.

Status

These tanks are not SWMUs and need no formal closure. However, this area needs further characterization and evaluation to allow redevelopment to proceed. It will be addressed in the Phase I Soil RFI Work Plan.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.20 CFC-11 and 12 Tank Area (AOPC 2.4)

Unit History and Description

CFC-11 and CFC-12 were stored in a series of above-ground tanks located in the southwestern portion of the CFC Manufacturing Area (see Figure 4-2). Recent soil gas investigation work using 2002 GORE-SORBER® has identified this area as a potential source area for the CFC plumes (see Appendix 5-4). A description of this AOPC and the status of this unit are shown in Table 4-1.

COPCs

COPCs for this unit are CFC-11, CFC-12, and CFC-113, although it is not known for certain that CFC-113 was stored in these tanks.

Investigation History

This unit was investigated during the 2002 GORE-SORBER® sampling activities. The data from these investigations are in Appendix 5-4.

Status

The CFC-11 and 12 Tank Area is not a SWMU and needs no formal closure; however, this area needs further characterization and evaluation to allow redevelopment to proceed. Additionally, data from the GORE-SORBER® soil gas survey (Appendix 5-4) shows that delineation for CFC-11 and CFC-12 is not complete. This unit will be addressed in the Phase I Soil RFI Work Plan.

Potentially Contaminated Media

Soil and groundwater are the potentially contaminated media.

4.2.21 Pigment Evaporation Basin (AOPC 2.5)

Unit History and Description

This AOPC received dredge spoil material from the North and South Retention Ponds. These ponds were used as retention ponds for TiO_2 manufacturing, with one pond being dredged every year. Dredge spoil material was placed in the Pigment Evaporation Basin until the mid 1980s. After that, the material was placed in the TiO_2 Landfill south of the TiO_2 Manufacturing Area (see Figure 4-3). The Pigment Evaporation Basin is located north of 6th Street and the railroad spur and north of the TiO_2 Manufacturing Area (see Figure 4-2). A description, number of samples collected, analytical results summary, and the status of this unit are shown in Table 4-1.

COPCs

COPCs for this unit are dioxins and furans, PCBs, hexachlorobenzene, pentachlorobenzene, barium, chromium, cobalt, copper, inorganic lead, iron, manganese, nickel, thallium, vanadium, and PCE.

Investigation History

This unit was investigated during the *Phase I Soil and Groundwater Investigation* for VOCs. One additional soil sample was collected in the vicinity of this AOPC (PBT-01) and had detections of dioxins and furans.

Status

The Pigments Evaporation Basin is not a SWMU and needs no formal closure; however, this area needs further characterization and evaluation to allow redevelopment to proceed. It will be addressed in the Phase I Soil RFI Work Plan.

Potentially Contaminated Media

Soil is the potentially impacted medium.

4.2.22 Sierra Crete™ Parking Lot (AOPC 2.6)

Unit History and Description

A parking lot in the CFC Manufacturing Area used Sierra Crete™ as a sub-base. The Sierra Crete™ material is consistent with material used in pads, road bases, etc. The exact dimensions are unknown. A description and status are summarized in Table 4-1, while the location of this area is depicted on Figure 4-2.

Note: The term "Area of Potential Concern" (AOPC) is a regulatory designation pertaining to non-regulated areas that may require further investigation or other action. Designating the on-site Sierra Crete™ test roads as AOPCs does not imply that they represent an unacceptable risk to human health or the environment. Rather, it is a way of ensuring that they will be adequately addressed as part of the corrective action process.

COPCs

Barium, chromium, cobalt, copper, inorganic lead, iron, manganese, nickel, thallium, vanadium, dioxins and furans, PCBs, hexachlorobenzene, and pentachlorobenzene are the COPCs for this area.

Investigation History

No samples have been collected from this area but the Sierra Crete™ is assumed to have the same properties as other locations that have been sampling on-site. Results of Sierra Crete™ sampling at several locations on site are summarized in Appendix 5-1a and 5-1b.

Status

Data collected for Sierra Crete™ at other locations on-site will be evaluated in the Phase I Soil RFI Workplan and a determination made as to the sufficiency of the data. If sufficient data exist the data will be compared to applicable risk screening criteria to determine if further action is warranted.

Potentially Contaminated Media

The road base material and the interface with the soil are the potentially contaminated media.